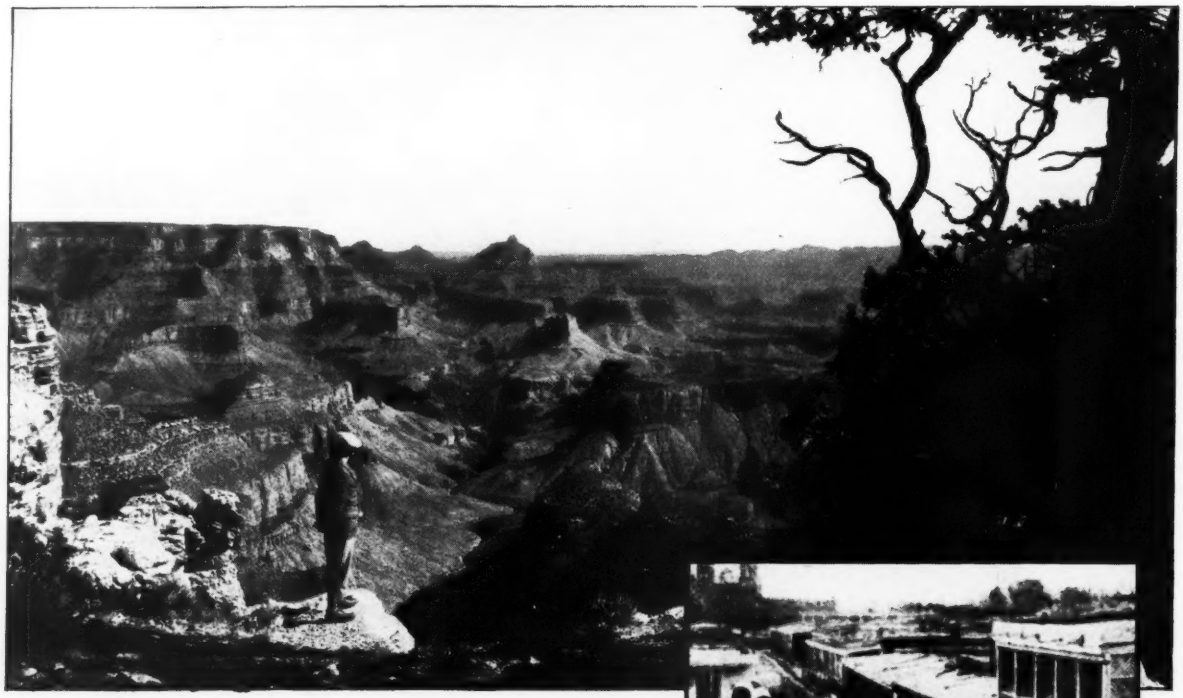
May, 1931

Railway Engineering and Maintenance



The END of the TRAIL...

but the Beginning of the Great Southwest

Indians blazed it. Gold-hungry Spanish Conquistadors discovered it. Prairie-schooner pioneers marked it—with their bones. The great Santa Fe Trail!

This was the romantic route to California selected by the founders of the Atchison, Topeka & Santa Fe Railway. Steadily, but with amazing rapidity, they pushed the iron tracks forward and onward, year after year, until their wild dream was turned into reality by reaching Santa Fe in 1880.

Most men would have rested content with such an epochal achievement—not these men! Again they ordered the rails forward, and then turned their attention to less spectacular but far more important matters. They planted the seeds of settlement which grew into teeming cities. They turned arid deserts into fields of glowing grain. They established industries, promoted trade, and made a neglected corner of the nation a prosperous empire.

When age finally stilled the hands of Holliday, Robinson and Strong, another generation took the helm. Today the third generation is following this inspired plan of service . . . Such are the reasons why the Santa Fe is more to millions of people than merely a great railroad system.

No. 5 of a Series Contributed by Leading Railroads

THE RAILROAD WORLD

Approved—by the *"strong left hand"*

JAMES J. HILL said his success was based on a "strong left continually holding back his right hand"—meaning that his development programs were always carefully guided by his financial means.

The outstanding contributions of the Railroad to American prosperity would never have been possible without "strong left hands"—without rigid inspection of every dollar spent on construction and equipment. Probably in no other field is proposed equipment subjected to such exacting tests.

Time and time again Fairmont products have conclusively proved the right to claim "Lowest Overall Cost" in service. On those grounds alone—millions of dollars have been expended for Fairmont Railway Motor Cars. The fact is—*more than half* the railway cars now in service are Fairmont-made!

FAIRMONT RAILWAY MOTORS, INC., FAIRMONT, MINNESOTA, U. S. A.

General Sales Offices: 1356 Railway Exchange Bldg., CHICAGO

District Sales Offices: New York City Washington, D. C. St. Louis San Francisco New Orleans

FAIRMONT RAILWAY MOTORS, Ltd., Toronto, Canada *Foreign Representative:* THE BALDWIN LOCOMOTIVE WORKS

Manufacturers of section motor cars, inspection motor cars, gang and power cars, weed burners, mowers, ballast discers, ball and roller bearing engines, push cars and trailers, roller axle bearings, wheels, axles and safety appliances

Fairmont S2 Steel Frame Section Car

6-11 H. P. Seven 3 inch structural steel channels form a rigid and well balanced frame to provide super strength and smooth, vibrationless riding quality.

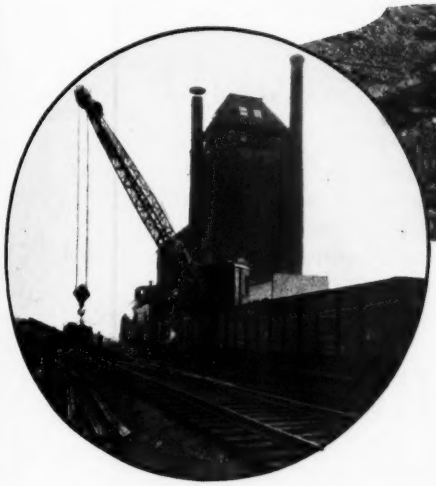
Fairmont Mudge

Performance on the Job Counts

K N O W S F A I R M O N T

Steers with the ease of a truck!

A feature that makes NORTHWEST worth more!



The Northwest patented crawler base brings supermobility to the user of crawler machines. The Northwest steers from the cab without lining the cab up with the crawler base. Positive traction is maintained on both crawlers while turning as well as while going straight ahead—100% power on both treads instead of 60% loss when power is needed most.

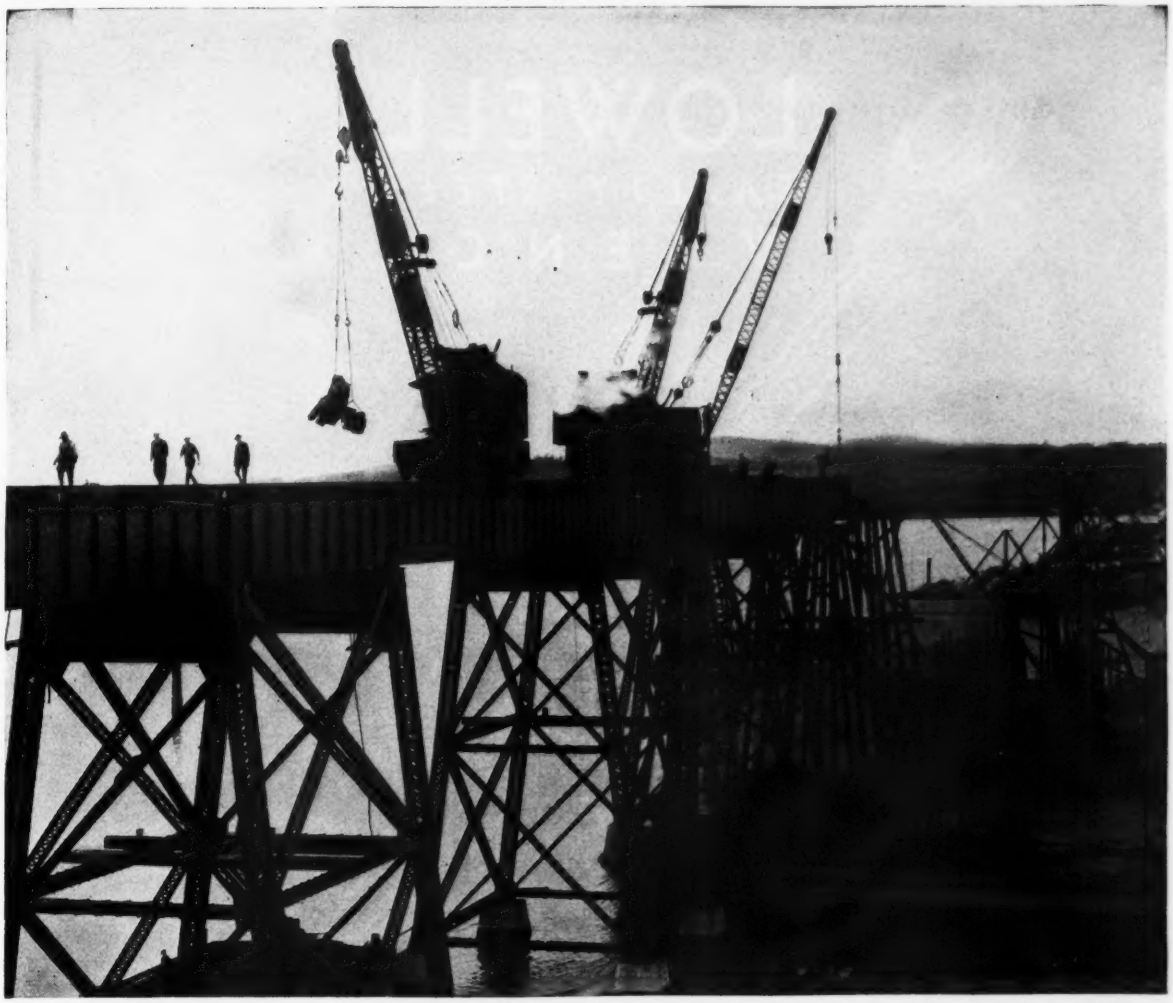
With this supermobility Northwests easily cross rails, travel from car to car, over platforms and ramps without delay in operation or destruction to flooring in much less time than is required with other types of crawlers.

It is one of the many reasons why over 40% of the crawler machines on railways are Northwests.

NORTHWEST ENGINEERING COMPANY
1713 Steger Bldg., 28 E. Jackson Blvd., Chicago, Ill., U.S.A.

NORTHWEST

The standa
by which
shovels ar
cranes a



Helping Erect the West's Largest Bridge

California's historic old train ferries, Solano and Contra Costa, are being retired. So ends one of the fascinating phases of western travel which survived for half a century but has now become too slow. In their place stands a monumental example of engineering and construction progress, the new Southern Pacific railroad bridge across Suisun Bay.

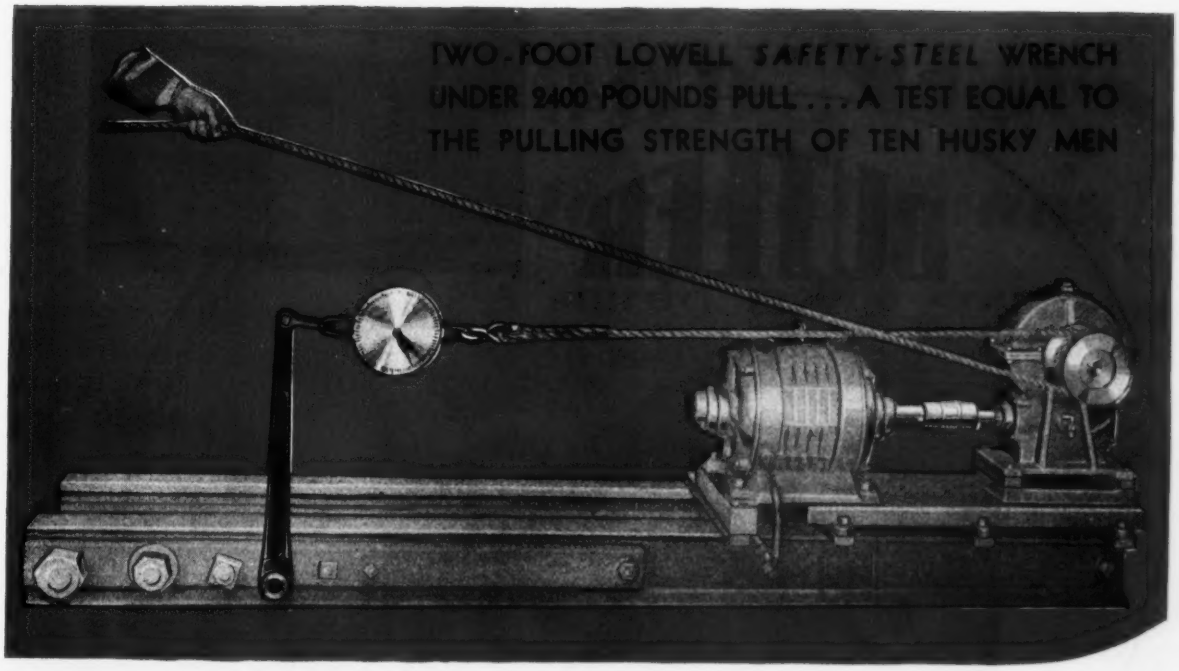
Forty-four million pounds of steel were required in the vast superstructure of this bridge. Erecting this steel was a difficult task and several Industrial Brownhoist heavy-duty erection cranes were used by the American Bridge Company on the work. The structure was completed in record time and six weeks ahead of schedule.

Greater speed at lower cost is the need today and nowhere is this more essential than in the handling of materials. Thousands of owners will tell you that an Industrial Brownhoist locomotive or crawler crane is the best answer to this challenge. You can determine this for yourself by letting our representative show you some of these cranes at work. The time spent will be well repaid.

Industrial Brownhoist Corporation, General Offices, Cleveland, Ohio

District Offices: New York, Philadelphia, Pittsburgh, Detroit, Chicago, New Orleans, San Francisco, Cleveland.
Plants: Brownhoist Division, Cleveland; Industrial Division, Bay City, Michigan; Elyria Foundry Division, Elyria, Ohio.

INDUSTRIAL BROWNHOIST



The New Lowell *Safety-Steel* Wrench Tested to Stand a Pull of 2200 to 2400 Pounds and Guaranteed not to Break . . .

The new Lowell *Safety-Steel* Wrench is made of an electrically treated metal of unusual strength. It is so strong that a 2-foot wrench cannot be bent or broken by ten men. Along with this added strength of metal, Lowell *Safety-Steel* Wrench has full enclosed ratchet and parts that have an absolute crushing action on hardened Steel Pawls.

Every handle of Lowell *Safety-Steel* Wrenches is unconditionally guaranteed not to break . . . a new handle without charge if one breaks. Put them to work soon.

LOWELL WRENCH CO.

WORCESTER, MASS., U. S. A.

PUMP IT HOME WITH SAFETY WITH A LOWELL *SAFETY-STEEL* WRENCH

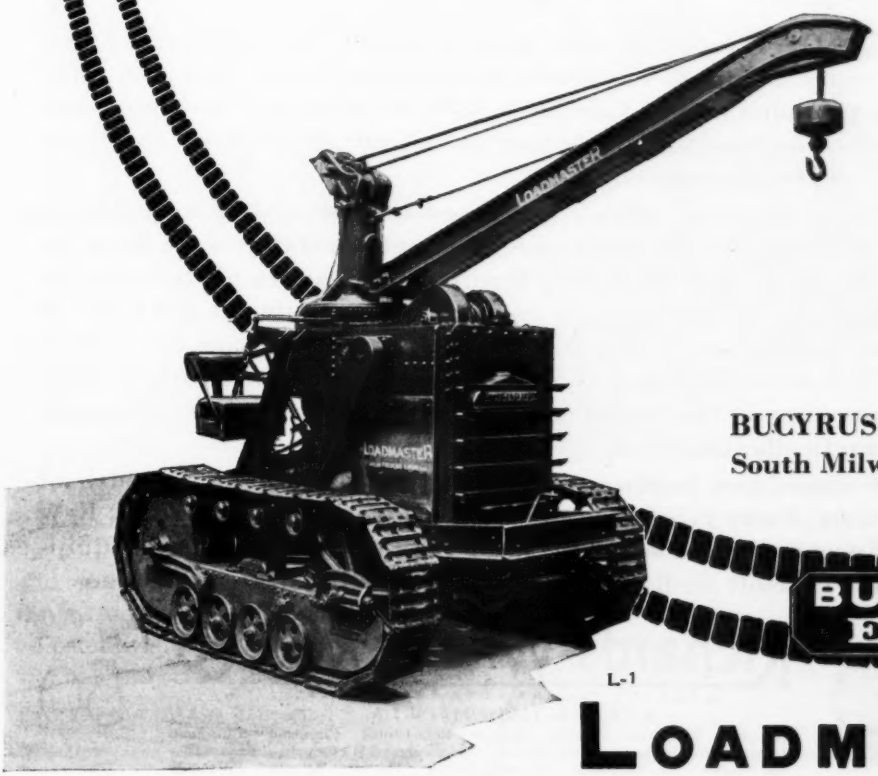
GOOD NEWS

... for Railroads!

A sturdy, mobile crane with full revolving boom

After four years of development and two years of gruelling field tests, the Loadmaster is offered to the industry by Bucyrus-Erie.

This general utility crane, mounted on either crawlers or wheels, can work in tight places—can work in places where you couldn't drive a motor car. And its job is not limited to lifting; it can travel with its load and can be used as a tractor; it can also be equipped with — 160 cubic feet air compressor — power winch with line-pull up to 12,500 pounds—bull-dozer.



Write for further details, on this new Bucyrus-Erie Product.

BUCYRUS-ERIE COMPANY
South Milwaukee, Wisconsin

BUCYRUS ERIE

L-1

LOADMASTER

Now~ you can buy this proven rail end slotting tool outright ~ it prevents chipped rail ends ~ and lengthens the life of the rail

TELEWELD
A MILE AT A TIME

A shaper bit efficiently trims the rail ends to the desired angle

THIS one-man, hand operated Teleweld Slotting Tool, which provides all the skill for beveling and trimming rail ends accurately, quickly and economically and weighs only 110 pounds, can now be purchased outright. Acquisition of all patent rights makes this possible ~ The Teleweld Slotting Tool positively eliminates chipped rail ends, and lengthens the life of new rail by retarding batter and deferring reclamation of ends. Approximately 3½ cents per joint will pay all labor and upkeep costs, as well as return the price of the Teleweld unit in a year's operation ~ Now, more than ever before, can you afford to be without this equipment?

ELECTRIC RAILWELD SALES CORPORATION, RAILWAY EXCHANGE BLDG., CHICAGO

New York • Cleveland • Salt Lake City • Boise • Spokane • San Francisco • Montreal

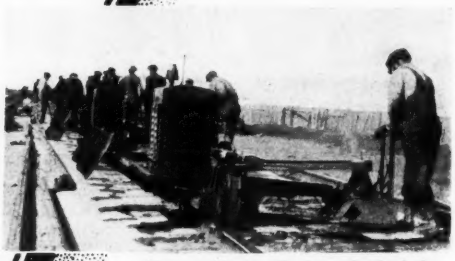
A "Short Time" Gang for a "Long Time" Job!

Expect to be handicapped this summer with "short time" gangs —with a lot of work to crowd into a brief period?

Then the Nordberg machines shown here will be of more than usual interest—because they are coming to the front every day in situations like this.

Their work measures up to your highest track standards.

With Nordberg Tie Adzers, perfect seats for tie plates on every tie may be secured—each level and in the same plane. Hindrance to traffic is of less duration—and the rail sets level and *stays* level.



Two machines easily keep ahead of the rail laying gang of 60 men.

When changing cutter heads or adjusting bits, the machine is tilted back, which allows the shaft and head to be easily removed.

These two Nordberg Adzing Machines adzed 3,040 ties in 3 hours.

Nordberg Spike Puller

With this machine, there's no longer any need for rail laying to be held up by the slow-moving spike pulling gang. Three men pull from 30 to 35 spikes per minute!

No matter how solid the ties or how rusted the spikes, they will be pulled without a starting blow from a spike maul; and the hazard of mashed fingers and injury from flying spike heads is eliminated. Spikes are not bent when removed, the pull being directly upward. Neither are the ties mutilated or damaged by the claw bar.

Railway Equipment Dept.

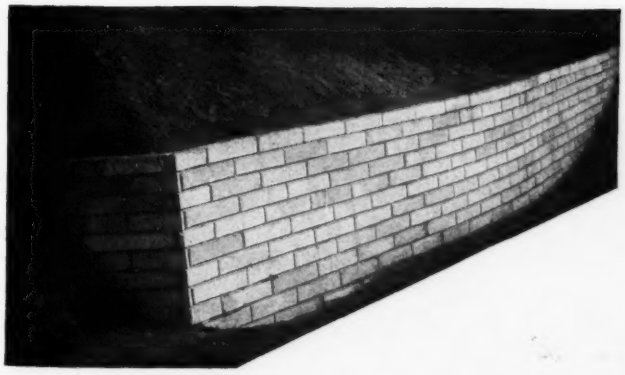
NORDBERG MFG. CO., Milwaukee, Wis. U. S. A.

NORDBERG

Today's Choice of Retaining Walls

because of these economies

Retaining walls constructed of precast concrete units, *cost less to build* than poured concrete walls—because all form work is eliminated—there is no stripping and no rubbing—no expensive foundation. And Federal 2-piece construction gives full salvage value if the wall is moved.



Compared to other cribbing systems, there are savings in labor handling *two* units instead of three or more—savings in maintenance costs, because of the *closed-face* design, characteristic of Federal.

More and more of these sturdy, permanent walls are being installed by prominent railroads, highway officials and industrials—many, after actual experience with them over a period of years. Our engineers are glad to submit full data for comparison.

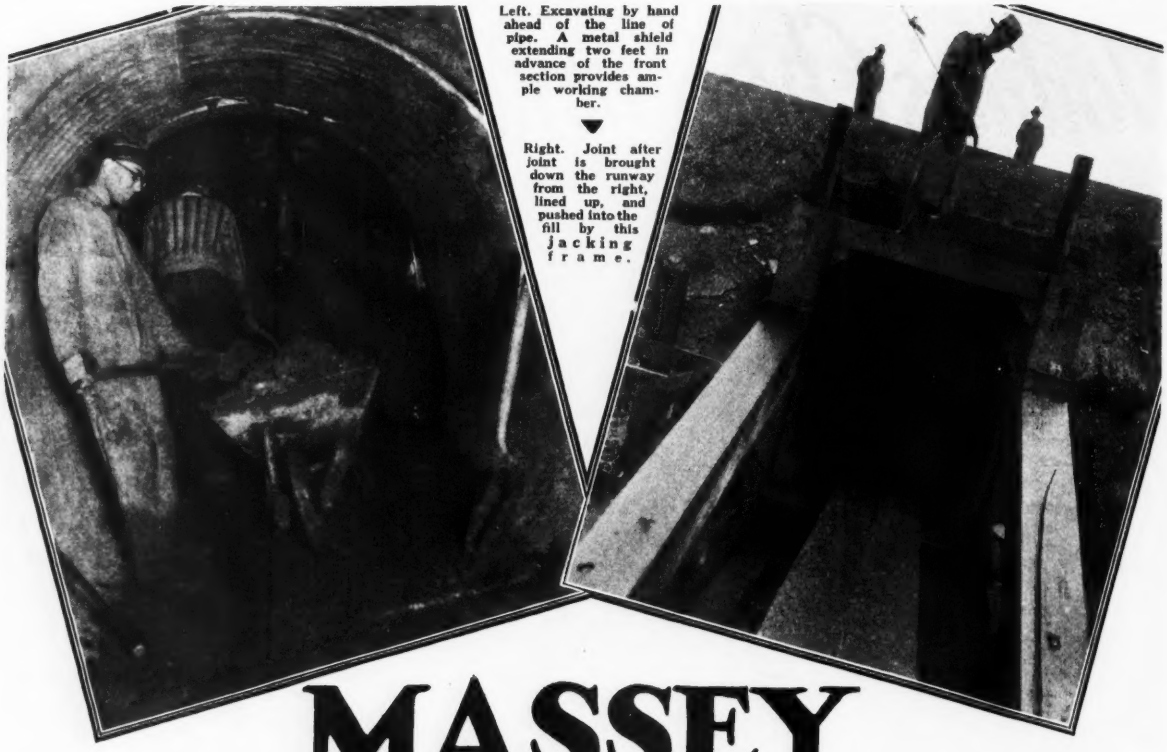
FEDERAL-AMERICAN CEMENT TILE CO.

Executive Offices: 608 South Dearborn Street - - - - Chicago

Plants Near CHICAGO - NEW YORK - PITTSBURGH - BIRMINGHAM

Concrete Products *for Over 25 Years*

FEDERAL 2 piece Concrete CRIBBING



Left. Excavating by hand ahead of the line of pipe. A metal shield extending two feet in advance of the front section provides ample working chamber.

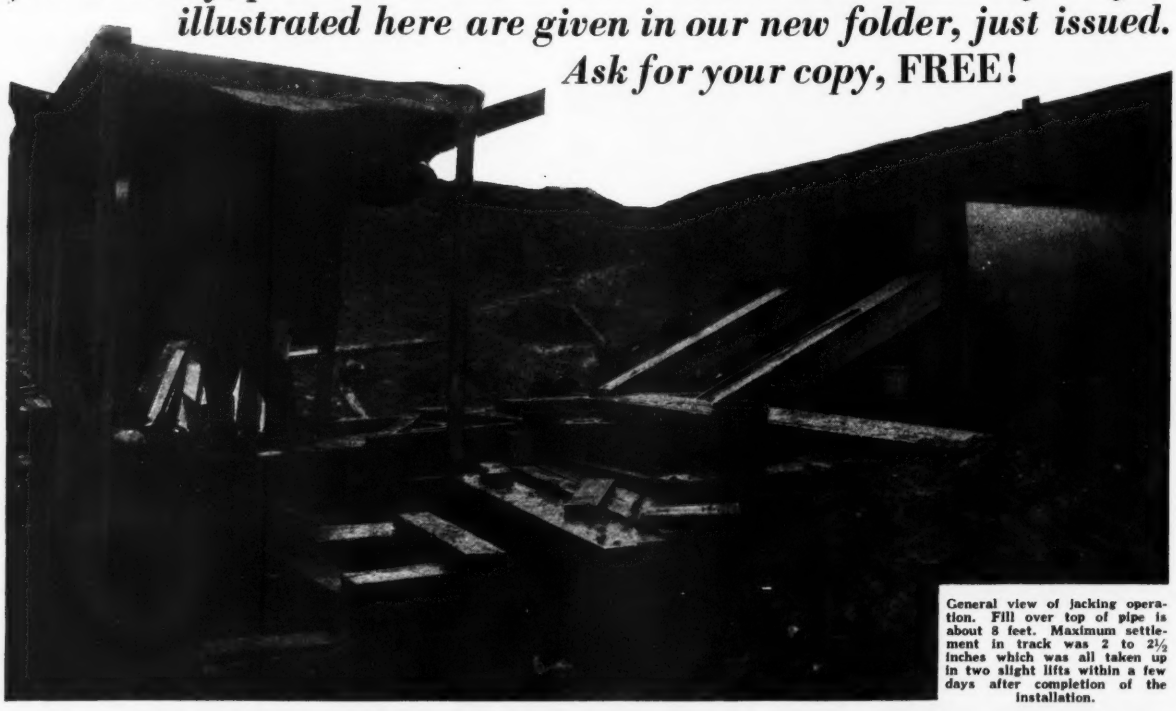
Right. Joint after joint is brought down the runway from the right, lined up, and pushed into the fill by this jacking frame.

MASSEY

FLAT BASE PIPE - JACKED TO PLACE

for economy, permanence and convenience. Full details of the job illustrated here are given in our new folder, just issued.

Ask for your copy, **FREE!**



General view of jacking operation. Fill over top of pipe is about 8 feet. Maximum settlement in track was 2 to 2½ inches which was all taken up in two slight lifts within a few days after completion of the installation.

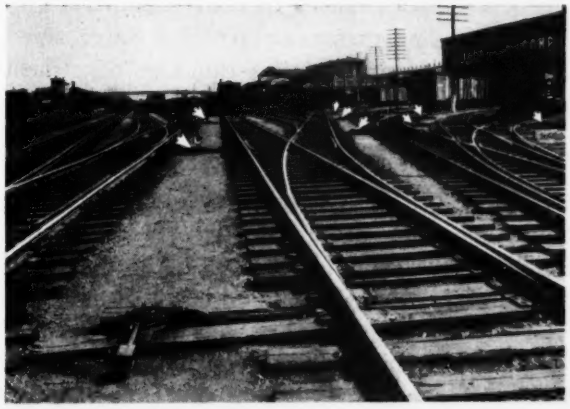
MASSEY CONCRETE PRODUCTS CORPORATION

Peoples Gas Building, Chicago. *Sales Offices:* NEW YORK, ATLANTA, CINCINNATI, ST. LOUIS, LOS ANGELES, 310 DOMINION SQUARE BUILDING, MONTREAL, QUEBEC

R.E.M. 5 Gray

New Century Switch Stands in large classification yard.

Switch Stands for every type of service



Bethlehem Model 1222 Switch Stands provide an extra margin of safety to the operator in this large yard.

Bethlehem Model 53A Switch Stands used along main line of a large eastern railroad.

■ NEW CENTURY SWITCH STAND

This stand has the strength and ruggedness to stand up under the heavy traffic conditions of high-speed main lines. Its heavy construction combined with a large base area provides great stability. The new Century Switch Stand has a certain amount of free play in the segment gear and a weighted throwing lever that makes throwing easier and assures positive closing of switch points.

■ BETHLEHEM MODEL 1222 SWITCH STAND

This model is an extra-low, parallel throw stand for use in yards where switch movements are necessarily fast due to heavy traffic conditions. The low construction of this stand, its parallel throw and weighted throwing lever, offer greater safety to the operator and to the traffic.

■ BETHLEHEM MODEL 53 SWITCH STAND

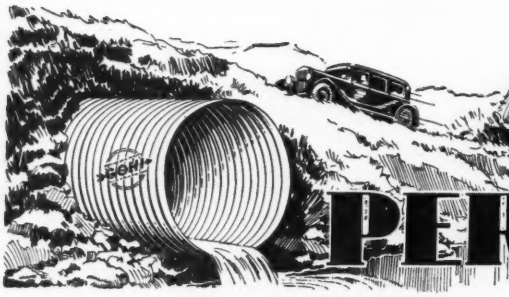
A superior stand for main line track that is especially designed with a low center of gravity and an extra wide base. The shape of the stand combined with its large base area makes it practically impossible to overturn.

BETHLEHEM STEEL COMPANY

General Offices: BETHLEHEM, PA.

District Offices: New York, Boston, Philadelphia, Baltimore, Washington, Atlanta, Pittsburgh, Cleveland, Detroit, Cincinnati, Chicago, St. Louis.
Pacific Coast Distributor: Pacific Coast Steel Corporation, San Francisco, Portland, Los Angeles, Seattle, Honolulu.
Export Distributor: Bethlehem Steel Export Corporation, 25 Broadway, New York City.

BETHLEHEM



In the Ground PERFORMANCE

. . . *that's what counts in a Railway Culvert!*

GOHI Corrugated Culverts have an outstanding record of actual service *in the ground*. Culverts that were installed more than twenty years ago show little or no deterioration today.

Such a record proves that GOHI Culverts are not only durable, but have the physical characteristics to hold together as inseparable units and withstand pressure of freezing water, shifting fills, and vibration of heavy trains — qualities of utmost importance in insuring long, dependable service without trouble or upkeep.

Back of the durability of GOHI Culverts is the rust-resisting base metal from which they are fabricated. This metal is GOHI, guaranteed 99.90% pure Iron-Copper Alloy. It lasts longer because of its extreme purity and copper content.

Add to GOHI Culvert durability the advantages of low first cost, ease of handling, low-cost installation, and you have the lowest-cost-per-year drainage service available. Write today to the nearest GOHI Fabricator for full details.

GOHI FABRICATORS

The Newport Culvert Co.
Newport, Ky.

The Pennsylvania Culvert Co.
Philadelphia, Pa.

Denver Steel & Iron Works Co.
Denver, Colo.

A. N. Eaton, Metal Products
Omaha, Nebr.

Feenaughty Machinery Co.
Portland, Oregon

Tennison Brothers
Texarkana, Ark.

Capital City Culvert Co.
Madison, Wis.

Central Culvert Co.
Ottumwa, Iowa

Roanoke Sales Corp.
Roanoke, Va.

St. Paul Corrugating Co.
St. Paul, Minn.

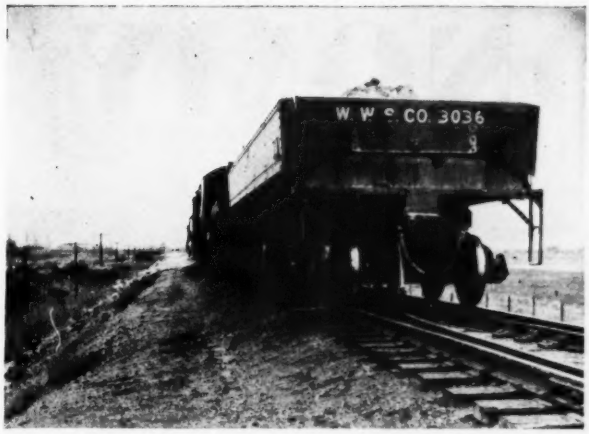
Tennison Brothers
Oklahoma City, Okla.

GOHI CULVERT MANUFACTURERS, Inc.
Newport, Kentucky

(GOHI Corrugated Culverts meet copper-bearing pure iron requirements in all accepted specifications for corrugated metal culverts).

GENUINE OPEN HEARTH IRON
GOHI
TRADE MARK
PURE IRON - COPPER ALLOY
REG. U.S. PAT. OFF.

GOHI
PRONOUNCED "GO-HIGH"
Corrugated CULVERTS



A Western Drop Door Dump Car handling rock for bank widening
This car is built in all practical sizes

A Study in Dump Car Efficiency

The heavy load has been easily and completely discharged

The track and ballast are protected by the down turning door

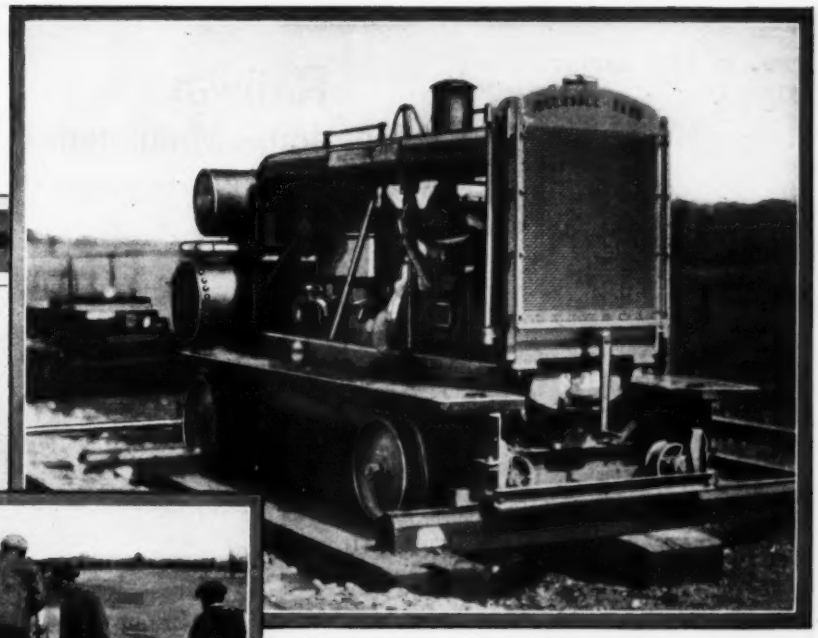
Note the wide shoulders; the distance to which the load has been thrown; the track clearance after dumping; the character of the material being handled.

Add to these visible advantages sturdy construction; few moving parts; low cost of upkeep; low air consumption; and you will begin to realize the efficiency and economy of the new Western Dual Side Pivot Dump Car. It is adapted especially to railway maintenance-of-way work. It can be operated with absolute safety under all conditions. We ask the opportunity to convince you of its superiority. Write for Catalog 81-A.

The load is thrown well away from the track and immediate clearance for regular traffic established

Western Wheeled Scraper Company, Aurora, Illinois

WESTERN
Western



Size 9"x8" Compressor supplying air power for 12 tool pneumatic tamping gang.

Pneumatic Tie Tamping

for Smoother, Safer, and Longer Lasting Track

Engineers on leading roads throughout the country have long realized that the kind of track they wanted could not be obtained with hand tamping and have standardized on Ingersoll-Rand Pneumatic Tie Tamping Outfits.

They have found that by using these machines they obtain a more uniform track, a safer track, and one that stands up two or three times as long as hand-tamped track.

INGERSOLL-RAND COMPANY
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Ingersoll-Rand

No. 29 of a series

Railway
Engineering and Maintenance
SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: Twenty Years

April 23, 1931

Dear Reader:

Twenty years ago this month the first issue of what has since developed into RAILWAY ENGINEERING AND MAINTENANCE appeared as the Maintenance of Way Section of the Railway Age. After appearing for five years as an insert in the third weekly issue of that publication it had gained sufficient strength and individuality by June, 1916, to stand on its own feet and was launched as a separate paper. Its growth since that date speaks for itself.

In these twenty years we have adhered steadfastly to the platform laid down in the initial issue, "To try to help the managements of the railways to increase the economy and efficiency of engineering and maintenance work——and particularly of maintenance work." Further on in this same announcement it was stated that "the most effective way that the Maintenance of Way Section can make itself useful to railway officers is by constituting itself a clearing house for new ideas regarding engineering and maintenance work."

A review of the early issues sheds interesting light on the changes that have taken place in maintenance practices in these two decades. As an illustration, the statement appeared in the initial issue that "Probably no recent development in the maintenance of way field offers so much promise of an increase in economy and efficiency as the motor car." This statement was based on a survey which showed that such representative roads as the Baltimore & Ohio then had 6 section cars in service; the Erie, 2; the New York Central Line, 14; etc.——surely a marked contrast with today when more than 40,000 of these cars are in daily use in section service. In the same issue there appeared a description of a home-made rail handling car, the forerunner of the cranes that are so widely used today.

Starting from scratch, our circulation has grown until today it includes 10,000 maintenance officers scattered over every railway of the United States, Canada and Mexico, with not a few in foreign countries. That our efforts have met with your approval is indicated by your renewal rate——78.06 per cent, an unusually high rate for a paper such as ours.

These twenty years have passed quickly. We hope that when another twenty years have rolled around we may merit the same loyal co-operation that is being extended so freely to us today. Incidentally, I confess to a sense of personal pride in the fact that throughout all of these twenty years it has been my privilege to serve as editor of this publication. Equally pleasing is the fact that through the last 16 of these years, Walter S. Lacher has served as managing editor.

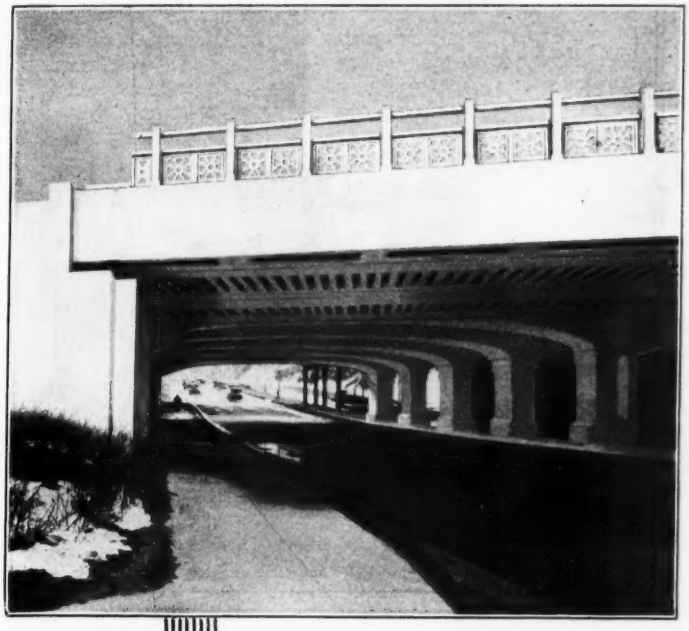
Yours very truly,

Elmer T. Howson

ETH*MM

Editor.

MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.



Painting
THE RAILROAD UNDERPASS

KEEPING railroad underpasses in good condition and well painted at a minimum of expense presents a problem. The solution lies in Medusa Portland Cement Paint. This paint is designed for painting exterior or interior concrete, brick and masonry surfaces. It is inexpensive in first cost, easy to apply and forms a beautiful, permanent, damp-proof, cement-like finish that is not just a coating but becomes a ***homogeneous part of the wall.*** It is exceptionally good for railroad work since it diffuses light and keeps all concrete and masonry plainly visible, thereby helping to prevent accidents. This paint can be applied to concrete the day the forms are removed—eliminating expensive, inconvenient waiting for concrete to dry out. ◆ Medusa Portland Cement Paint resists the disintegrating action of acids formed by rain and fumes in the air, as well as the chemical action of lime and alkalies, which causes other paints to scale and peel off. Medusa Portland Cement Paint can be secured in white, blue, green, cream, stone gray, pearl gray, and red. Every railway executive in charge of maintenance will be interested in the book "How to Paint Concrete and Masonry Surfaces." Fill out the coupon below and let us send you a complimentary copy.

MEDUSA PORTLAND CEMENT CO. · 1002 Engineers Bldg. · Cleveland, O.

Manufacturer of Medusa Gray Portland Cement (Plain and Waterproofed); Medusa Waterproofing (Powder or Paste); Medusa White Portland Cement (Plain and Waterproofed); Medusa Portland Cement Paint and Medusa-Mix, the Masonry Cement

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Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

MAY, 1931

Railway Engineering and Maintenance

GRADE CROSSINGS

The Railways Plead for Fair Play

Second only to subsidized highway and waterway competition in the seriousness of its effects on the railways and on those who look to the railways for their livelihood, is the widespread and growing demand that is being made by public authorities and the public at large for the separation of grades with the highways at so many points. This demand, which in any large way is of relatively recent origin, is not confined to any one area but extends from Maine to California. Neither does it produce any increased business for the railways or reduce operating expenses. It is entirely an out-of-pocket expense incurred for the public welfare, a fact which the public at large frequently does not appreciate.

Not of Railway Origin

The grade crossing problem as it now exists is essentially not of railway origin. It is a result of the automobile, the motor bus and the motor truck. These vehicles have introduced a new era in local transportation. They have brought to the highway a volume of traffic that was unthought of a generation ago. Furthermore, this traffic moves at a much higher speed than the horse-drawn vehicles which preceded them. The result has been a greatly increased frequency of accidents on the highways at large, creating a problem that our public authorities have not yet solved. This is best shown by the fact that 1,000 people are being killed annually in automobile accidents in the single city of Chicago and the area contiguous thereto, while in the entire United States the loss of life from this cause now exceeds 30,000 annually—a slaughter so large that it would have stirred the nation with horror a few years ago; yet it is today accepted by the public largely as a matter of course.

With such conditions existing on our streets and highways, it is not surprising that the number of accidents at intersections of railways and highways at grade would increase. Any other result would be contrary to all expectations. Yet the increase in the number of accidents at grade crossings in recent years has led to unwarranted criticism of these crossings as a menace to highway travel. Influenced by the not infrequent prominence given by the newspapers to a particularly unfortunate and serious accident at such a point, the public overlooks the far greater number of people that are being killed on our streets every day without any public clamor and gains the impression that the grade crossing problem is more of a menace than the facts warrant, whereas less than 8 per cent of the accidents occur here.

Such persons do not know that fewer persons were killed as a result of accidents at grade crossings in 1930 than in any year since 1922, according to statistics compiled by the Interstate Commerce Commission. In this year the number of deaths at grade crossings *decreased* 19 per cent or from 2,485 in 1929 to 2,020 in 1930. This record is all the more noteworthy by reason of the fact that in the same year there was an *increase* of approximately 4 per cent in other fatalities on the highways and the further fact that the use of the highways and the number of accidents thereon have been growing steadily for a number of years.

This record is equally striking with reference to the number of persons injured, for in 1930 there were only 5,517 injured at grade crossings, as compared with 6,804 in 1929. Likewise the number of accidents at these points decreased from 5,975 in 1929 to 4,853 in 1930. At a time when the number of accidents on the highways as a whole is increasing, a decrease such as this in a particular group is especially significant and indicates that a measure of control is being developed here that is not found elsewhere on the highways. Such a record deserves the widest possible dissemination by every person interested in the welfare of the railways.

A reduction such as this in the number of accidents at grade crossings in a period when highway accidents are increasing elsewhere is not the result of chance. On the contrary it is directly traceable to the widespread efforts made by the railways to acquaint the public with the necessity for the exercise of caution when crossing railway tracks, supplemented by the installation of protective or warning equipment at many points. The fact that these measures have produced results in so short a time is an indication of the far greater results that are possible when public authorities awaken to the same appreciation of their possibilities. Furthermore, if the co-operation of public authorities could be secured to the point where they would enforce obedience to warning signals when displayed at grade crossings, the results would be still more pronounced.

Universal Grade Crossing Elimination Impractical

The rapidly increasing traffic on the highways is a particularly serious threat to the railways by reason of the growing demand for the separation of grades and the vast expenditures that are required for these improvements. The Class I railroads of the United States alone are now spending nearly $30,000,000 per year ($28,445,680 in 1930) for this purpose. A single railroad, the Pennsylvania, has spent $8,500,000 for this purpose in the state of Ohio alone in the last 13 years, while the

Long Island Railroad is devoting 80 per cent of its entire improvement budget to this one class of projects. Yet these demands are increasing every day.

Furthermore, many municipalities are endeavoring to place the entire burden of the cost of grade separation on the railways. Yet the railways themselves have created no new additional hazards at these crossings, for in general the growth in railway traffic has been by longer trains rather than by increasing the number of trains. On the contrary, the increase in the hazard has resulted from the growth of the traffic on the highways and from its higher speeds. Furthermore, the benefits of grade separation accrue directly to the public and the public should, therefore, pay the larger part of the cost. An increasing number of public regulatory bodies are coming to an appreciation of the justice of this position and in some states, as in New York, it has already been recognized to the point where the state itself pays half the cost of improvements of this character.

What Employees Can Do

At first thought it would appear that the grade crossing problem is one solely for railway managements to consider; yet employees are appreciating more largely today than ever before that any influence that affects the railway adversely is equally detrimental to their own interests. They owe it to themselves, therefore, to contribute whatever they can to the proper solution of the question. Among those measures which maintenance employees can take are the following:

1. They can so maintain the crossings and protective devices on the lines under their supervision that the hazards are reduced to the minimum. This includes the removal of brush and other obstructions to provide the maximum visibility, the elimination of sharp approach grades and narrow approaches, the provision of proper construction between and across the tracks in order that a driver's attention need not be drawn from the approach of trains up and down the track, the proper location and maintenance of approach signs, warning lights, bells and other protective devices, etc.

2. They can acquaint those with whom they come in contact with the fact that a crossing of railway tracks at grade is of necessity a hazardous point which should be approached with care and with regard for any warning indications that may be displayed.

3. They may inform those with whom they come in contact that the railways are the one agency which has undertaken to educate the highway user in the necessity for the exercise of care, and that as a result, is showing a decreasing accident record in the face of the growing use of the highways and of a rising casualty record elsewhere. They can point out that if such a result is being secured it is possible to visualize the still greater results that can be attained when such methods are applied to traffic universally.

4. They can make it their business to see that those who clamor for grade separation are informed as to the tremendous and prohibitive cost of any universal program of this character and that they also see that the cost is not one which should properly be placed on the railways alone but is one whose benefit is accruing more largely every day to the public and that it should, therefore, pay a large proportion of the cost.

It is an axiom that the American public is fair when it understands the facts. It is a responsibility which railway employees owe their managements to see that that part of the public which they come in contact understands the facts regarding grade crossings, the extent of their hazard and the division of responsibility between the railways and the state for their elimination.

ON UNITS

How Much Material Does a Railway Use?

How much material does a railway use in the construction, betterment and maintenance of its properties? This is a question that is often answered in terms of the tonnage involved or of the value of the material, but seldom in terms of individual units. It is of more than passing interest, therefore, that the Missouri Pacific announces that from 1923 to 1930, inclusive, it laid 2170.5 miles of 85-lb., 90-lb., and 110-lb. rails and that the Gulf Coast Lines, which are a part of its system, laid in addition 849.3 miles of 85-lb. and 90-lb. sections, bringing a total for the system to 3019.8 miles. During these years the Missouri Pacific, exclusive of the Gulf Coast Lines, also installed 28,963,454 tie plates and 3,534,933 anti-creepers.

These figures are so large as to be incomprehensible without some comparison as a guide. This number of tie plates is sufficient to equip every tie on a five-track railway between Chicago and New York or New Orleans, the rail exceeds the amount necessary to lay three tracks between these points, while the anti-creepers are more than would be required for two of these tracks, if applied six to the rail.

These quantities, in themselves, are so large that the mind refuses to grasp them; yet they represent only a few of the many activities of a single road which constitutes but a small percentage of the total railway mileage of North America. When the consumption of the multitude of other devices, constituting about 70,000 individual items which the railways use every year, is similarly analyzed, some appreciation is gained of the far-reaching influence of the railways in the industrial activities of the country.

TRACK TOOLS

How to Prevent Accidents While Using Them

For more than 20 years the railways have engaged in organized safety work. While they have reason to be proud of their accomplishments so far, much remains to be done, as indicated by the current slogan "33 by 33."

Injuries resulting from the use of track tools do not constitute a very large percentage of the total accidents that occur on any railway. Yet the number of such accidents is larger than it should be, since they are almost invariably preventable. In the use of tools, two axioms

should always be kept in mind: First, that no tool should ever be used unless it is in a good state of repair and is not worn beyond the limit of safe operation; and second that tools should never be used for any purpose other than those for which they are designed.

Alert supervision is the next most important factor in eliminating personal injuries from the use of tools. The foreman should demonstrate the proper use of tools to inexperienced men as soon as they enter the gang. He should then watch the men to make certain that they are following instructions. He should also exercise constant watchfulness to insure that the men do not become careless in the handling of the tools, not only with respect to themselves but to their fellow workmen as well.

Although the foreman has a definite responsibility in this form of accident prevention, supervisors have an equal responsibility. It is their duty to know that the foremen under their jurisdiction are requiring their men to follow safe practices. It is true that most of the injuries resulting from the use of tools are of a minor character; yet if these simple and workable rules were followed consistently in every gang, even the number of minor injuries would become almost negligible in an exceedingly short time.

GOOD TIES

Reduce the number but not the quality

For the five years ending with 1904 the annual tie renewals per mile of track on 16 railways averaged 242. At the end of 1929 the corresponding average for 27 roads was 180, or a saving for 62 ties per mile on a total of 210,611 miles of tracks. This aggregate figure does not, however, measure up to the improvement that has been made on individual railways embraced in this record. On the Lackawanna, for example, the reduction in demand during this period of 25 years amounted to 137 ties per mile; on the Lehigh Valley to 179; on the Northern Pacific to 162; etc.

The object lessons in the economies of tie preservation thus afforded have been stressed frequently, for it is readily possible to show in dollars and cents how much more it would have cost any individual railway to make its current tie renewals if the annual requirements today were as great as they were 20 or 25 years ago. But there is another advantage of a low renewal requirement that has come in good stead in this period of straightened circumstances for many properties. We refer to the possibility of effecting a marked curtailment in the renewals in any one year without seriously affecting the average tie condition. Take the case of a railway having annual requirements of 100 ties per mile. If the renewals for one year are cut one-half or to 50 ties per mile, the requirements in the following year will be only about 150 ties, or appreciably less than the average annual demand on many other properties.

Obviously, such measures are not advocated except as a matter of sheer necessity, but they are much to be preferred to a policy that involves a letting down in the size or quality of ties purchased, in the character of treatment given, or in any other practices that will result in shorter life for the ties that are installed. A temporary deficiency in the tie renewals can readily be made up in following years, but a reduction in the standards of quality will result in a definite loss in the form of decreased service life.

THE DROUGHT

Recent Rains Bring Needed Relief

The widespread rains which have occurred in recent weeks give indication that the unprecedented drought of 1930, which actually began late in 1929 and extended well into 1931, has been broken. Although it is not possible to predict the conditions which may obtain during the late spring and summer, the fact remains that for the moment these rains have given much needed relief to railway water supplies which, in many instances, had practically reached the point of exhaustion.

While the area affected by the drought included most of the territory east of the Rocky mountains, conditions were especially severe in the central section of the country extending east from Kansas and Oklahoma. The lack of rainfall for such an extended period had a disastrous effect on railway water supplies. Stream flow diminished and in many instances failed entirely. Ponds and reservoirs, receiving little or no inflow, were rapidly depleted. Subsurface supplies were less affected, but there is now a marked recession in the ground water level that is particularly noticeable with respect to shallow wells and springs.

During the latter part of the dry period, conditions became serious, even on those roads which through foresight or natural advantages continued to obtain sufficient water to meet their needs. Not infrequently, through contamination or the concentration of undesirable solids or corrosive materials, it became necessary to give special attention to methods of treatment to counteract the unfavorable quality of the waters which had to be used.

Although both operating and water supply officers in many sections of the country have ample reason to remember the drought of 1930 as the worst in their experience, it is improbable that such severe conditions will occur in the near future. For this reason, those supplies that were ample during the recent period of subnormal rainfall should give no immediate concern. But how about the supplies that failed?

Some railway officers may be inclined to assume that a recurrence of these conditions is improbable or that if they do occur it will be so infrequent as not to warrant taking measures to prevent water failures at some indefinite time in the future. It would seem, however, that serious study should be given to the situation at every such point of supply to determine whether such measures are feasible and what they will involve.

It should be kept in mind that in the more densely populated areas of the country the number of unappropriated sources of water is diminishing yearly. Failure to obtain water rights now may mean that the opportunity to do so will be lost when the need for them is pressing.

How Much Will It Save?

Final article in series sums up economics of the track motor car in maintenance work*†

By C. R. KNOWLES‡

THE details of the construction, operation and maintenance of track motor cars have been discussed in the earlier articles of this series and it appears fitting that this closing chapter should be devoted to a summary of the economics of the motor car. Space will permit taking into consideration only certain classes of service and the discussion is, therefore, confined to the principal uses for motor cars and the savings possible therefrom.

The motor car has become so firmly established in railway work that the question of its economy is now generally conceded and rarely enters into consideration when any question arises regarding its use. In many departments of railway operation the motor car is looked upon as an indispensable tool. This is true especially in the track, signal and telegraph departments where it is generally admitted that it would be practically impossible to adhere to the present standards of maintenance without the motor car, except at greatly increased expense, if at all.

It is true that the use of motor cars can often be justified from the standpoint of expediency, entirely aside from the savings they effect. For this reason it is doubtful whether the full savings resulting from their use are adequately appreciated. It is sometimes difficult to express their full value in dollars and cents, for while in most cases it is entirely possible to show the economies effected through their use in saving labor, it is more difficult to fix a figure for their value in handling materials, for inspection purposes, in meeting emergencies and the many other uses to which they are put, where the savings, while very real, are more or less intangible. In the figures which follow, the estimates of savings include labor only, as other savings are so intangible that it is difficult to prepare any accurate figures.

Motor Cars Save Time for Section Gangs

Cost of Ownership

In arriving at the economies effected through the use of motor cars, it is necessary to take into consideration the cost of owning and operating them. It is not a difficult matter to determine the expense of operating and maintaining all of the cars in use on a railroad as the cost may be determined easily by checking the charges to motor cars as carried in the accounts, but the determination of the cost of an individual car or group of cars in a certain service necessitates rather detailed records or careful estimates based on an intimate knowledge of the actual conditions under which the car or group of cars is operated. These costs should include interest on investment, depreciation, maintenance, supplies, cost of operation and cost of accidents.

A Car with a Trailer Saves Time and Money in Handling both Men and Materials

In preparing the estimates of costs submitted herewith, the figures have been checked with the records of the actual cost of operating and maintaining more than 3,200 cars over a period of years. These records cover 32 different types or classes of cars made by 8 different manufacturers. In preparing the figures, it was necessary to make some adjustments in apportioning the expense to certain classes of cars in the different kinds of service. Also, the cost of accidents is estimated from the records of accidents in the various classes of service.

In comparing the cost of accidents with motor cars and with hand cars, the Interstate Commerce Commission's records for the last seven years have been used as a guide. It is estimated that hand cars represent about 10 per cent of the total of all motor and hand cars in service on the railroads of the United States. Nearly 9 per cent of the deaths and more than 22 per cent of the

*This is the concluding article of a series of 15 articles on the care and operation of motor cars which have appeared consecutively, beginning with the January, 1930, issue, excepting the March, 1930 and 1931 issues.

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injuries in non-train hand and motor car accidents, as reported by the Interstate Commerce Commission over a period of 7 years, are chargeable to the operation of hand cars. It would appear, therefore, that hand cars and motor cars share equally in accidents in operation, although for the purpose of comparing operating costs it has been arbitrarily assumed that accidents are only two-thirds as numerous with hand cars as with motor cars. There are no records of accidents with velocipede cars, but they are undoubtedly less hazardous than with either hand or motor cars, so that in comparing the cost of accidents in connection with the operation of velocipede cars it is assumed to be only 20 per cent of that with motor cars.

In Track and Bridge Work

Approximately 70 per cent, or about 40,000 of the 60,000 motor cars in use are employed in the maintenance of tracks and structures. The most striking result from the use of motor cars in track work is reflected in the number of sections that have been reduced through their use. This is in addition to the time saved by the men in getting to and from the job.

Reports presented to the Interstate Commerce Commission some years ago showed that it was possible, through the use of motor cars, to reduce the number of sections and effect a marked saving in the hours expended in non-productive travel. A reduction of 103 sections, or 10.7 per cent of the total number, was effected on one railroad through the use of motor cars, by which means it was estimated that a saving of approximately $136,000

The Saving is Proportionately Greater for Extra Gangs

per annum was effected through the decreased number of sections, in addition to further economies aggregating $150,000 resulting from the use of the cars themselves. On another large Western road figures were presented which indicated a saving of $379,800 through the operation of 1,266 cars. A third road having 689 cars in service estimated a monthly saving of $21,796, while a road with 180 cars reported a saving of more than $1,000 per car per annum, or a total saving on all cars of $194,193. On still another road it was estimated that the use of motor cars on practically all portions of the line effected a saving of $300,000 per annum, while a further road having 700 motor cars in service estimated savings of $400 per car per year.

The above figures refer chiefly to savings effected through the reduction in the number of sections which was made possible through the introduction of the motor car. It is difficult to draw a definite line of demarcation between the savings effected through the reduced number of sections and those resulting from the reduction of non-productive travel time through the use of the motor car. It is generally agreed that the saving in time through the use of the motor car as compared with the hand car amounts to an hour each day for the men and

The National Railways of Mexico Have Found the Motor Car Economical for Telegraph Gangs

foreman on the average section. On this basis, the net saving through the operation of motor cars in track work is as follows:

Annual Cost of Operation of a Motor Car

Interest on cost of car, $250 @ 6 per cent	$15.00
Depreciation, based on life of 10 yrs.	25.00
Cost of operation, 240 days @ 0.15	36.00
Maintenance	35.00
Accidents	15.00
Miscellaneous supplies, batteries, spark plugs, etc.	12.00
	$138.00

Annual Cost of Operation of a Hand Car

Interest on cost of car, $60 @ 6 per cent	$ 3.60
Depreciation, based on life of 10 yrs.	6.00
Maintenance	7.50
Accidents	10.00
Oil	.50
	$27.60
Increased cost of operation of a motor car over a hand car.	110.40
Saving per annum for a gang of 4 men—4 man-hours per day for 240 days, 960 hr. @ 0.40	$384.00
1 hr. foreman per day for 240 days, 240 hr. @ 0.65	146.00
Total	$530.00
Saving resulting from substitution of motor car for hand car	$419.60

It will be noted that after deducting the difference in cost between the operation of motor cars and hand cars there is a net saving of $419.60 per car per year.

The saving resulting from the use of motor cars by extra gangs is much greater than in ordinary section service by reason of the longer distances traveled and the larger number of men employed. Extra gangs commonly number from 20 to 100 men and while the cost of operating their cars is greater than in section service, the saving is also proportionately larger. For example, assuming that the cost of operating an extra gang car is double that of the ordinary section car, we have a total annual cost of $276 or $1.38 per day, while the saving, based on a gang of 20 men, would be 40 hr. per day for the men and 2 hr. for the foreman, or $17.30 per day, a net saving, after deducting the cost of operating the motor car, of $15.92 per day.

A conservative estimate of the saving effected with motor cars in bridge gang service is 20 per cent of the total time of the gang. Therefore, assuming a gang consisting of 8 men, each receiving $4.80 per day, and a foreman at $6 per day, we have a total gross saving through the use of a motor car of $8.88 per day. As with the extra gang car, the expense of operating bridge gang cars is in excess of that of section cars, and if we again double the cost of operating section cars we have a total daily expense for car operation of $1.38, which, deducted from the gross saving, gives a net saving of $7.50 per day.

This figure takes no account of the value of the motor car in mobilizing gangs and in meeting emergencies, a consideration of particular importance in bridge work for which no specific figure can be assigned.

In Telegraph Service

If the motor car is indispensable in the maintenance of tracks and bridges, it is even more so in the upkeep of telegraph and telephone lines as it enables a lineman to get to points of trouble when a train is not available and to travel distances far beyond the range of a velocipede car. The territory commonly assigned to a telegraph lineman today varies from 70 to 100 miles of lines. It would be impossible for one man to cover this mileage without a motor car. The use of a velocipede car limits a man to 10 miles of line or less, with the result that he has to depend very largely on train service in covering any territory in excess of that mileage. As a result, without the motor car, approximately three linemen would be required to do the work now performed by one man with a motor car. The work of the telegraph lineman has increased immensely in recent years. The maintenance of telephone circuits and the increased importance of establishing and maintaining uninterrupted lines of communication have added so materially to his duties that it would be impossible to maintain these facilities to their present high standard without the motor car.

The cost of operating motor cars such as are used by telegraph linemen in ordinary maintenance work is given in the following tabulation. A figure of $225 is used for the cost of the car, this figure probably being high as many of the lower priced cars are used in this service.

Annual Cost of a Motor Car

Interest on cost of car, $225 @ 6 per cent	$13.50	
Depreciation, based upon life of 10 yrs.	22.50	
Operation—200 days @ 0.24	48.00	
Maintenance	30.00	
Accidents	15.00	
Supplies, batteries, spark plugs, etc.	12.00	
		$141.00

Cost of a Velocipede Car

Interest on cost of car, $65 @ 6 per cent	$3.90	
Depreciation, based on life of 10 yrs.	6.50	
Maintenance	5.00	
Accidents	5.00	
Oil	.50	20.90
		$120.10
Saving—2 men at $140 per mo.		$3,360.00
Less difference in the cost of a motor car over velocipede car		120.10
		$3,239.90

In Signal Service

The motor car is universally used in the maintenance of signals, in which capacity, as with the maintenance of telegraph and telephone lines, it is almost indispensable. The location and number of interlocking plants influence the mileage assigned to a signal maintainer, the territory ordinarily assigned varying from 25 to 40 miles and in rare cases up to 70 miles. Where the longer territory is assigned, the maintainer is usually provided with a helper.

The average distance traveled daily by the signal maintainer is approximately 30 miles. Since the work of inspecting and maintaining signals can not be handled by train, it is conservatively estimated that each motor car used in this work saves the time of one man at $160 per month or $1,920 per year. Deducting the cost of operating and maintaining the motor car for a year, on the same basis as for cars in telegraph service, we have a net saving through the use of motor cars of $1,779.

In Miscellaneous Service

Another common use for motor cars is in the transportation of car riders in hump yards, a task for which the motor car is particularly adapted and one in which the economies are readily apparent. The saving is equivalent to the cost of operating a locomotive for the corresponding number of shifts per day. The cars used in this service are of the heavy duty type. The estimates of the cost of operation and the savings effected are based on the operation of four cars in two hump yards, one located in the middle west and the other in the south. In each case two cars are provided, one of which is held in reserve. These cars cost $750 each, or $1,500 for the two cars.

The Use of a Motor Car Like This to Return Riders in a Hump Yard Saves a Locomotive

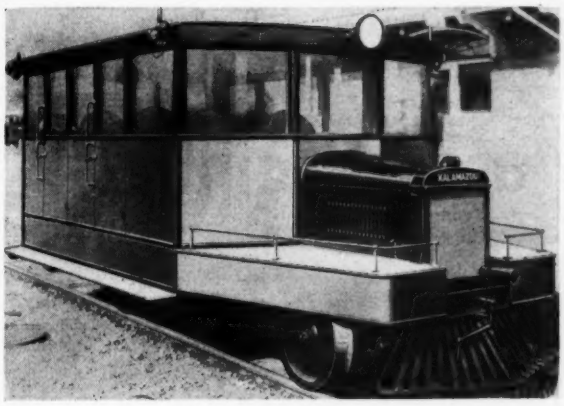
Interest at 6 per cent amounts to $90 per year or 30 cents per day, based on 300 days' operation per year. The depreciation on cars in this class of service is more rapid than in ordinary maintenance of way work and the life of the car is therefore estimated at six years, resulting in an annual depreciation charge of $250 per year or 83 cents per day.

The daily cost of operating and maintaining a car of this type for an eight-hour shift is as follows:

Interest on investment	$0.30
Depreciation	0.83
Operator's wages	6.00
Maintenance	1.00
Supplies, batteries, spark plugs, etc.	.10
	$8.23

In the event that a car is operated for more than one shift, the interest and depreciation will be reduced accordingly.

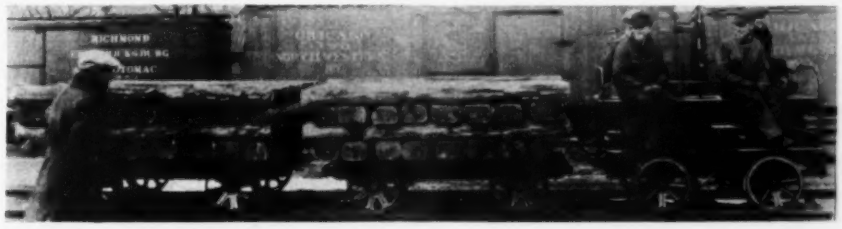
The cost of a switch engine for each eight-hour shift, including an engineer, a fireman and one man, is $48.56. Therefore, the saving through the use of a motor car in hump yard service amounts to $40.33 per shift.



Inspection Cars Like This Often Obviate the Expense of Inspection Trains

The value of the motor car as a substitute for a work train is reflected in the reduction in work train mileage in recent years. It is difficult to evaluate this saving with any degree of accuracy for the reason that other influences also affect work train mileage and also for the reason that a part of the saving effected in handling extra gangs is accounted for in the labor saved in the reduction of unproductive travel time where such gangs are moved by motor car instead of work train. During the five-year period from 1923 to 1927, inclusive, there was an average annual reduction of 11,549,000 work train miles which, at 70 cents per mile, represented a total saving of $8,084,300. At least 60 per cent of this saving, or $4,850,580, can be properly credited to the use of motor cars, in addition to such other savings as have been made in labor.

The number of large party inspection cars in use is constantly increasing as this type of car has very largely replaced the special train formerly used for inspection purposes. Therefore, there is a direct saving in this respect and in all probability a still greater saving by reason of the convenience and availability of a car of this kind for general inspection purposes.



The Demand for Work-Train Service has been Greatly Reduced by the Increased Use of Motor Cars and Trailers in Distributing Materials

Essentials to Economy

A discussion of the economics of motor cars would not be complete without comment on the necessity for utilizing motor cars to the fullest possible extent. As a rule, the earning power of the motor car is so great that it has to be operated for only a relatively short time to pay its carrying charges; however, to realize the greatest possible return it must be operated continuously. As shown in the preceding computations, the cost to own and operate the average section car aggregates $138 annually, while for each day that a motor car is operated the net saving in section service amounts to $1.75. Therefore, a car must be operated 85 days out of each year in order to effect a saving equal to the cost of owning and operating it; unless a car is operated for this length of time, it is a liability instead of an asset. On the other hand, every day that a car is used in excess of 85 days per year represents a net economy of $1.75.

Motor cars are idle principally because they are laid up for repairs or are improperly assigned. Under a proper system of operation and field maintenance, general repairs to a car should be anticipated and any special parts ordered for delivery before the car is shopped. This should reduce to a minimum the time that a car is out of service and also keep down the cost of repairs.

The assigning of cars exclusively to intermittent service where they will be used for only two or three days each month, as for example, for the use of line checkers, timber inspectors, bridge inspection and similar work means a high proportion of idle time. On the other hand, if this work is properly scheduled, one car can often meet several different intermittent demands with a corresponding increase in efficiency and economy.

Another factor which enters into the economics of motor car operation and maintenance, particularly the latter, is the age of the car and its effect upon the cost of maintenance. A life of 10 years has been fixed as the economical limit for a motor car, although there are many cars in service with a much greater life; on the other hand, many cars have been retired after much shorter service. There is undoubtedly a time beyond which it is no longer economical to continue the maintenance of a motor car; while the general condition of a car should be considered, it should, as a general rule, be retired when the annual cost of maintenance equals 50 per cent of the cost new.

The care that a car receives and the manner in which it is operated and maintained—all of which may be summed up in good motor car operation—are factors affecting the economics of motor cars. These features have been covered in a general way in preceding articles, but their effect on the savings possible should not be lost sight of. Good operation of a motor car not only leads to certain economies through the reduction of the expense for maintaining it, but also increases the earning power of the car by avoiding delays that are a natural result of poor operation and that keep it out of service for too frequent field or shop repairs.

Summing up the economics of motor cars, it is apparent that a car will effect a saving ranging from $2 to $40 per day, depending on the kind of service in which it is used and the manner in which it is operated and maintained. It has demonstrated its worth beyond a doubt, especially as a unit on maintenance of way work equipment, in many branches of which it is indispensable. The motor car is here to stay.

TWENTY-FIVE YEARS AGO.—The appalling calamity of earthquake and fire which on April 18 involved a large area of San Francisco in ruins does not appear to have caused material property loss to the railways terminating on San Francisco bay.—From the *Railway Age* for April 20, 1906.

Lehigh Valley Modernizes Water Facilities

By E. J. CULLEN
Division Engineer, Lehigh Valley, Buffalo, N. Y.

A GENERAL survey of water conditions on the Lehigh Valley was made recently with the view of improving existing water stations, providing for the treatment of water where required, and discontinuing, where possible, stations supplying poor water. This survey included every point of supply on the entire system and was conducted for the purpose of aiding in decreasing locomotive and stationary boiler maintenance expenses, increasing the dependability of motive power and lowering the consumption of fuel.

As a result of this investigation the treatment of water was found to be desirable at Manchester, N. Y., a division terminal 68 miles east of Buffalo. At this point the Lehigh Valley has a large classification and forwarding yard about 1½ miles in length, with about 60 miles of tracks. The facilities also include a large engine terminal, a mechanical coal handling plant and extensive facilities for icing refrigerator cars. One of the largest transfers in the world for the handling of less than carload freight, known as "Manchester Transfer," is located here.

Water for this terminal is received from the outlet of Canandaigua lake, one of the Finger lakes in New York state, at a point about six miles from the lake. This stream, which affords a never-failing supply of water, shows an average hardness of 9½ grains per gallon and an average alkalinity of 7½ g.p.g. In addition, the water contains sewage and trade wastes. A study of other available water supplies within a 10-mile radius was made, but the general characteristics of all were found to be practically the same as those of Canandaigua outlet.

This stream is located at the extreme easterly end of Manchester yard, where, at the time of the investigation, the Lehigh Valley maintained a steam pumping plant consisting of two large steam pumps and two vertical boilers, which were enclosed in a brick building. The stream is about 40 ft. below the elevation of the yard. The engine terminal is located nearly a half mile west of the pumping station and at this point there were two wooden storage tanks having a capacity of 50,000 gal. each, as well as a steel storage tank of 100,000 gal. capacity, a short distance away. Water was fed to these tanks through eight-inch and six-inch lines.

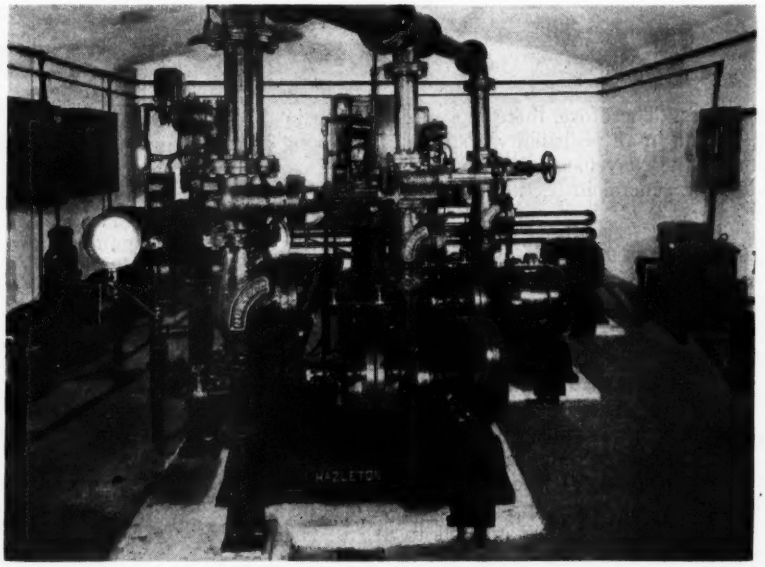
About a mile farther west, at practically the extreme westerly end of the yard, there is a fourth storage tank having a capacity of 100,000 gal. The elevation of this tank is 58 ft. above the general yard elevation and it is supplied through a six-inch line from the easterly end.

The consumption of water at this terminal averages over 1,000,000 gal. daily, so it can be seen that the savings possible through the use of treated water would be considerable and should warrant the necessary expenditure for constructing water-treating facilities. From the study of the water situation, it was found that, in addition to the savings which could be effected through the treatment of water, economies could also be effected through the substitution of electrical pumping equipment for steam equipment.

Pumping Equipment

It was decided, therefore, to install three motor-driven, direct-connected centrifugal pumps, each having a capacity of 34,000 gal. per hr. when operating against a head of 130 ft. With each pump capable of delivering over 800,000 gal. of water daily, it is evident that an ample reserve was provided, making it necessary to operate two pumps during the peak hours only.

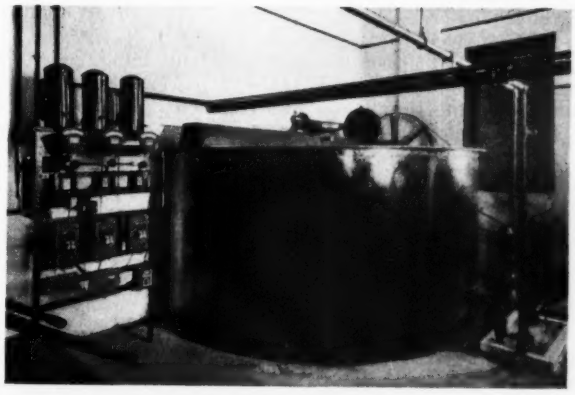
However, in view of the importance of this water station it was deemed advisable to install a third pump to be used as a spare. It was found that insofar as the consumption of electricty is concerned, greater economy of operation could be obtained by the installation of three small pumps, than by the installation of two larger pumps. Each of the three pumps requires a 25-hp. motor. In view of the desirability of utilizing the existing steam pumping station and pump foundations, it was a difficult problem to determine how the installation of the electric pumps could be made without interrupting the operation of the steam pumps, as the pump room was quite small.



An Interior View of the Pumping Station

Yard improvements include the erection of an up-to-date treating plant and the replacement of steam by electrical equipment

The Chemical Storage Room Showing Part of the Mixing Vat Protruding Through the Partition at the Left



The Chemical Mixing Vat and the Electrical Assembly for Automatic Operation

This problem was solved by placing the new pumps in a diagonal position with respect to the walls of the pumping room. This permitted the removal of one steam pump, while the other was kept in continuous operation, and the installation and operation of two of the electric pumps. The second steam pump was then removed and the third electric pump installed.

The new pumps are operated by remote control from the water-treating plant, which was erected about a half mile from the pump house, and for this reason it was necessary to provide automatic operation for the pumps and to safeguard their operation as far as possible with safety devices. At this point it might be well to mention some of the safety devices that were installed to insure complete automatic operation.

Priming Pumps Necessary

Since the pump house floor is 15 ft. above the elevation of the stream it was necessary to install vacuum priming pumps to exhaust the air from the centrifugal casing and suction line. The vacuum pumps are controlled by push-button starters located at the water-treating plant. After these pumps are started and the air is exhausted, water rises through the centrifugal casing to a priming chamber located above the centrifugal pumps. A float switch in this chamber starts the centrifugal pumps and at the same time shuts down the vacuum pumps through relays.

Provision also was made to allow the vacuum pumps to be started from the pumping station as well as from the treating-plant. Pressure regulators were installed so that if the pump pressure falls below normal owing to a suction air leak or a broken discharge pipe, a pressure regulator switch opens and shuts down the pumps. Vacuum regulators also were installed so that if the vacuum at the intake becomes too great because of blocked suction, a vacuum regulator switch opens and shuts down the pumps. Time relays are used to limit the time during which the vacuum pumps can be run and if the centrifugal pumps do not start after three attempts, an alarm circuit is closed, ringing a siren located at the treating plant and lighting a bulb at that point showing which of the three pumps is non-operative.

The Treating Plant

The water-treating plant was constructed in close proximity to the engine terminal. This plant involves the lime and soda process of softening water and has a capacity of 68,000 gal. of water per hour. It includes a steel tank 47 ft. in diameter and 49 ft. high which permits a six-hour reaction period and provides storage for 150,000 gal. A 12-ft. down-comer was erected through the center of the tank and an extensive system of sludge piping was installed at the bottom of the tank to permit quick removal of the sludge. The sludge disposal system is actually three separate systems, each taking care of one-third of the tank. The sludge line empties into an old ash pit a short distance away.

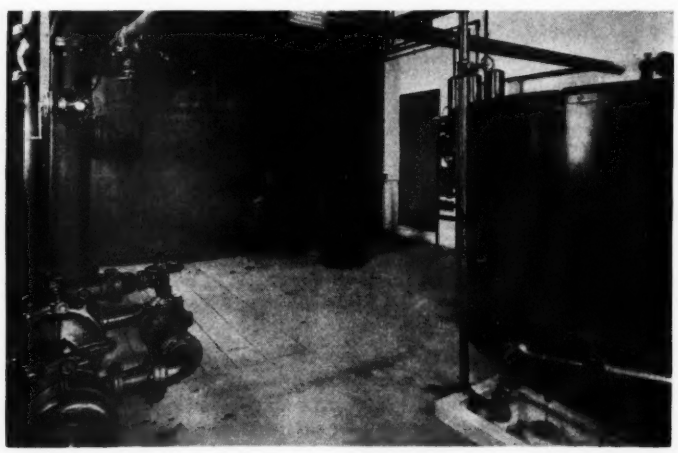
A brick and steel building was erected directly adjacent to the tank, which is divided into two rooms, one containing the chemical mixing tank, proportioning apparatus, chemical pump, etc, and the other being used as a storeroom for chemicals. The floor level of the latter room is three feet higher than the level of the chemical room, which brings it approximately to car floor height and permits the easy unloading of chemicals from a box car to the storeroom. The chemical mixing tank is 12 ft. in diameter and 5 ft. 6 in. high and is so located that it is about three-fourths in the chemical room and one-fourth in the storage room. A partition separating the two rooms runs directly over the tank. This permits the dumping of chemicals into the tank from the storage room without any of the dust getting into the chemical room. A series of perforated baffle plates through which swing paddles operated by means of a belt-driven 5 hp.

motor are located inside the tank. This motor also drives a triplex pump which is used to pump the chemical mixture into the top of the treating tank.

Water Readily Treated

The chemicals used in clarifying the water at this point are lime, soda and sodium aluminate. It was found that the water, being essentially a carbonate type, but with about two grains of sulphates, lends itself readily to treatment, producing a large flock which quickly settles out. The use of sodium aluminate was found to hasten the reaction and to permit a lower hardness of the treated water without excessive over-treatment. There is also little likelihood of after precipitation. Contrary to early expectations and owing to the good flock produced in the water, the sewage is readily removed.

The chemical solution is pumped from a small concrete sump into which it is fed by means of a circular swing pipe operating inside the chemical tank. This swing pipe is automatically raised or lowered by means of a cable which is attached to a meter placed on the raw water line entering the 47-ft. tank. In addition to registering the flow of water, the meter has a reduction gear attached to its main shaft on which is mounted an aluminum drum. One end of the cable is attached to this drum and as the water passes through the meter, the drum unwinds the cable, lowering the swing pipe in the chemical tank and thereby proportioning the chemicals to the flow of raw water.



Above—View of the Treating Plant. Right—Another Interior View of the Chemical Room

The chemical room also encloses part of the raw water inlet, the treated water outlet, a sludge line, the electrical apparatus and a booster pump. The electrical apparatus consists of the necessary relays, transformers, selector switches, and altitude regulators.

Operation by Regulators

These altitude regulators are of the Bourdon tube type and are controlled entirely by the pressure in the water tank. The first regulator is set so that when the water level in the tank drops one foot, contact is made and one of the vacuum pumps located in the pump house is started, which, in turn operates one of the centrifugal pumps, as explained previously. When the water level drops an additional three feet, another altitude regulator starts the second pump in the pump house. Correspondingly, when the water level rises, the regulators shut down the pumps.

Owing to the fact that the tops of the two 100,000-gal. steel tanks mentioned previously are 11 ft. above the treating tank and also because of the length of the 6-in. line supplying the westerly steel tank, a booster pump was installed in the heating house. This pump has a capacity of 220 gal. of water per minute and is operated by a 5-hp. motor which is automatically controlled by a third altitude regulator in which the principle of operation is the same as in those previously mentioned.

The Power Supply

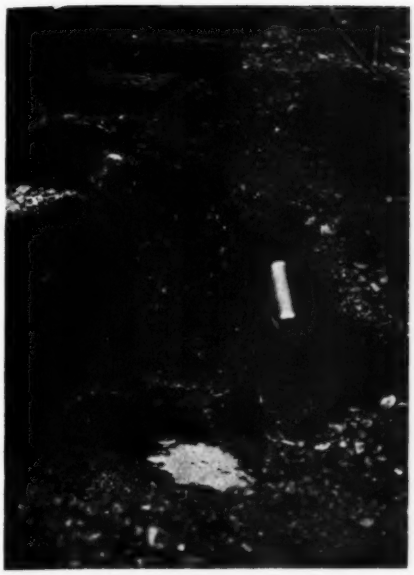
The power supply at this point is received from a local power company and in order to provide for any emergency which might result from trouble in the power company's supply, it was decided to connect the power supply line to a steam turbine located in the engine terminal. Another emergency measure was the construction of a connection to the water supply of the village of Manchester.

With the construction of new pipe lines, totaling about a mile in length, and an 11,000-volt power line one-half mile long, the installation was complete. The plant is operated by one man working eight hours daily. His duties are to make tests of the raw and treated water, prepare chemical mixtures, dispose of sludge, maintain pumps and electrical apparatus and unload chemicals from box cars to the storeroom.

Since this plant was put into operation, the hardness of the water has been reduced to slightly less than 2 g.p.g. and all the suspended matter has been removed. The stationary boilers at this location, which were previously cleaned every 15 days, recently completed a 74-day period between washouts in a cleaner condition than when first put on the line at the last washout period, thus indicating the fulfillment of the anticipated improvement in operation.

The plant has now been operating since September, 1930, and as a sludge was built up in the tank the treatment has been improving until we are now securing water with a hardness slightly less than 2 g.p.g, which is considered satisfactory during operation in the winter. It is anticipated that with warmer weather, it will be readily possible to have this softener produce water having a hardness less than one grain per gallon.

The complete installation of these facilities was made under the supervision of the writer.



Showing Close Proximity of Water to Rail Near Bernice

Stabilizing Soft Track

Effective cure requires thorough removal of water by systems designed to cope with individual conditions

TRACK maintenance problems arising from the settling, shifting or sliding of the roadbed because of poor drainage continue to be among the most perplexing and troublesome with which maintenance of way men are confronted. Efforts to effect complete and permanent solutions of the problem have led to the application of numerous remedies, which, however, have in many instances resulted in only partial or temporary cure of the faulty condition. Through their experience with these remedies, maintenance men have generally come to the conclusion that the only practical solution of the problem in the majority of cases is the thorough draining of the roadbed by a system designed to cope with the conditions existing at the particular location. The need, therefore, is for more thorough investigation of individual locations and some attempt at an effective design of drainage systems.

Accurate records of excess maintenance charged to soft spots in the track which take up a disproportionate amount of the section crew's time, will show whether the expenditure of enough money to cure them is justifiable. Careful investigations will disclose the source of trouble and often suggest a practical cure of the faulty condition.

An example of this is offered by an illustration from a middle western railroad. On a five mile section near Bernice, Ill., a piece of track about 500 ft. in length was requiring an unusual amount of attention to keep it in condition for high speed traffic. Maintenance records showed that in a year the time charged to the five mile section was 9,984 man-hours, including the foreman's time, or a cost of $4,817, while the time spent on the short troublesome section was 1,248 man-hours, and the cost $622. On this track the average maintenance cost per lineal foot for normal roadbed was 16.2 cents. At this rate, the justifiable cost per year for the 500 ft. would have been $81, whereas it was $622, or an excess annual cost of $541.

A thorough investigation of conditions at this point developed that the trouble was caused by water impounded in ballast pockets in the gumbo fill, which were in close proximity to the base of rail. The cost of draining the water from this roadbed was estimated to be $580 or only slightly more than the amount of money expended each year for excess maintenance at this point.

In another instance near Milford, Ohio, a sidehill fill was giving considerable trouble. Piling had been driven at this location several times to check the sliding but had not been found altogether satisfactory, partly because of the rotting out of the piling and partly because saturated fill material continued to escape through the openings between the piles. A line of 12-in. perforated pipe installed on the uphill side of the tracks intercepted some of the water which was causing the saturation but was not getting all of it. In an investigation to locate the source of the water entering the fill, more than 80 exploratory borings and pits were sunk, many of them to a depth of from 20 to 25 ft. These served to establish accurate cross-sections of the interior of the fill at a dozen or more places, and an analysis of the accumulated data indicated precisely the nature of the trouble and the most practical cure.

A Bad Combination

The embankment was found to consist of soft and disintegrated shale mixed with yellow clay and loose rock. This was from 5 to 12 ft. thick, resting in some places on a pocket of gravel and in others on shale. This material had a very low bearing power when satur-

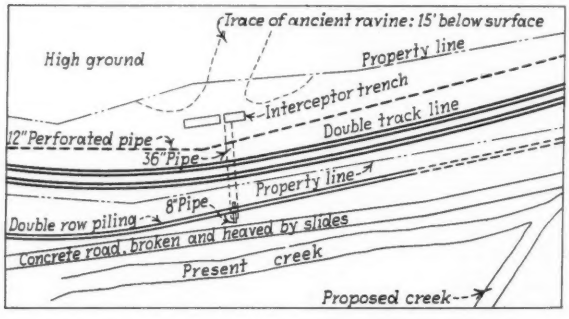
Fifteen Lines of 8-in. Pipe Were Used to Drain the Water Pockets in this Fill Near Spencerville, Ind.

ated, but solidified satisfactorily when dry. A sub-grade of cinders and gravel overlaid the shale, and in turn was overlain by ballast. The cinders had pushed down under the impact of trains until a large part of the clay had been pushed out to the side and formed a thin slab on the downhill slope. Surface water draining from the adjacent slopes gained access to the foundation material by filtering through from faults or strata in the hillside under the fill.

An Ancient Ravine

Water pockets were located as deep as 20 ft. below the surface of the roadbed and all surface water or rain falling directly on the embankment entered these pockets through the ballast and cinders and remained there to saturate and soften the foundation. Observations of out-cropping strata and the material encountered in one of the pits indicated that an ancient ravine, which apparently had been filled in for many years, was still acting as a carrier of seepage water which followed the general direction of the slope of strata. This water was being conducted into the fill and passed on through it, keeping it in a plastic and unstable condition.

Under these conditions the indicated cure was control of the water which was the cause of the trouble. This could be done by the interception and diversion of the



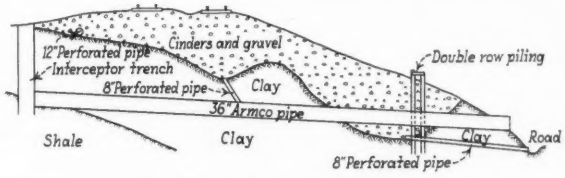
Plan of the Troublesome Location at Milford, Ohio

surface water and the water from faults on the uphill slope, and removal of the water impounded in the ballast pockets. Surface ditches were assisting a great deal in the diversion of surface water, and prevented a considerable amount from entering the fill. The line of 12-in. perforated pipe already installed served to intercept the surface water from above the tracks but was not deep enough to tap the subterranean flow from the fault line or the ancient ravine. To accomplish this, an intercepting ditch deep enough to collect this water and a pipe to convey it through the fill and into the ditch on the downhill side were recommended. Ballast pockets were held largely responsible for the track settlement on the eastbound main line and their drainage by means of perforated pipe was recommended. It was found also that asphalt-coated pipe of the paved invert type as a means of protection against the corrosive effect of the cinders was desirable for this location.

A Successful Experiment

On the strength of these investigations, it was decided to select the most troublesome place in the 1,000 or more feet of defective track and try out the suggested cure. An intercepting trench 15 ft. deep and about 100 ft. long was dug parallel to the tracks on the uphill side, and a line of 36-in. Armco paved invert pipe, 104 ft. long, was jacked through the fill from the downhill side to drain water away from this intercepting ditch. This pipe, besides acting as a conveyor, also tapped one water pocket along the toe of the piling, from which water flowed at the rate of 12 gal. a minute for the first two days. This pocket was several feet below the adjacent paved highway, which prevented the 36-in. line from being placed at the bottom so as to drain it completely. For this reason it was necessary to install a short line of 8-in. perforated pipe approximately four feet below the larger line. Another pocket under the eastbound main line was tapped by a short length of 8-in. perforated pipe which was pushed up through the bottom of the pocket and drained into the 36-in. line.

This work was done early in February, 1930, and immediately produced a continuous flow of water from



The Drainage Installation at Milford

the fill. For about a month the 8-in. line flowed at the rate of 3 gal. every 5 min., and the 36-in. pipe discharged 2 gal. a min. The installation was inspected in January, 1931, at which time both the 8-in. pipes showed a trickle of water. The flow is said to increase rapidly during rains, which would indicate that the pipes were receiving the surface water and removing it almost immediately from the fill. The results obtained during almost a year of operation were found to justify the completion of the drainage system and present plans contemplate this in the near future.

Poor Track Requires Three Hours Daily

Another somewhat similar situation was found on the main line of a railway near Spencerville, Ind., where a 25-ft. fill had been sliding frequently for years. Sliding alternated from one side to the other, and in order to keep the track in usable condition it was necessary for the track gang to spend about three hours each day in this location. When the fill was originally constructed a cast iron pipe culvert had been placed about six feet above the flow line of the stream. The result was that water repeatedly backed up over several thousand square feet of swamp area on the upstream side, gradually filling it up to the flow line of the culvert with a light, sandy silt. This material was in a saturated condition continuously and in turn kept the foundation of the fill in a wet and plastic state.

This fill was explored in much the same manner and as thoroughly as in the case previously described, although a different condition was found to exist. The fill was composed chiefly of sand, held in place partly by impervious material. Clay and stone screenings had been added for raising the track up to grade after slides, and as both of these materials were more solid than the sand, they worked downward, displacing the sand, which escaped along the toe of the slope.

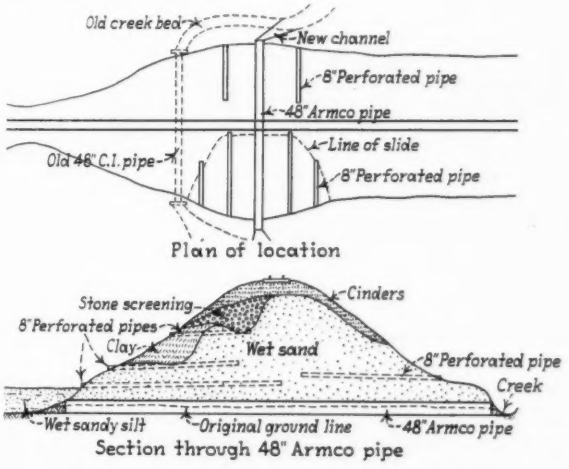
As a remedy at this location, piling had been suggested, but the discovery that the fill was composed of sand caused the recommendation to be discarded. It was reported that this remedy would have been effective only if the piles were spaced close enough together to prevent the sand from flowing between them. It was also thought

that such a remedy would have caused the retention of a large amount of water which might well have resulted in the whole fill going out at once.

The treatment subsequently installed at this point consisted of a 48-in. Armco culvert for draining the swamp on the upstream side, which was jacked through the fill with the flow line at or a little below the original ground line, or approximately six feet below the cast iron pipe, and 15 lines of 8-in. Armco perforated pipe for draining all water impounded in the fill, which were inserted with a small pipe jacking machine.

The Boring Machine

The machine used to install this pipe is a comparatively recent development, although several thousand feet of pipe have already been installed with it. In consideration of the fact that the operation of installing drains by the open trench method often necessitates a slow order and leaves the roadbed unsettled for some time until the backfilled trenches have become stabilized, the need for such a machine becomes evident. This unit consists of an earth augur attached to a spiral conveyor working inside a casing, which in turn is inside the corrugated pipe. The conveyor removes the excavated material, while the pipe is jacked forward into the fill. The power is furnished by a gasoline engine.



Plan and Cross Section of the Fill at Spencerville, Ind.

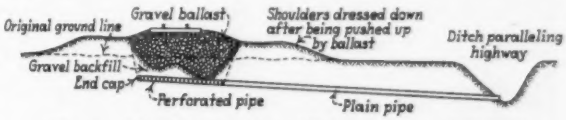
By using this machine, drains can be placed so as to tap the bottom of deep ballast pockets in high fills without the expense and inconvenience of opening up trenches in the roadbed. This machine is a recent Armco development and has been used on a number of different projects where it has proved efficient and economical in operation.

Economically Justified

At Spencerville, the annual excess maintenance cost for the troublesome fill was estimated to be $1,527. The total cost of the drainage system was $3,000, and its annual cost, including interest on the first cost and the annuity to replace it in kind at the end of its estimated life, is expected to be a few cents under $200, so if the system eliminated only one-fifth of the excess maintenance, it could be considered an economical improvement.

It is reported, however, that the fill appears to be completely stabilized and since the installation of the system in May, 1930, only maintenance which is normal for the rest of the section has been given it. In computing the excess maintenance shown above, only about one and one-half crew-hours per day were used instead of the three hours per day. This estimate does not include the excess operating expense caused by slow orders which would probably increase the amount considerably.

It has been found that the sooner that some action is taken toward the drainage of ballast pockets, the cheaper will be the cure. One condition that is occasionally encountered is where pockets have existed for several years and have gradually pushed down below the natural ground. When this occurs the cost of drainage is increased considerably because of the necessity for a longitudinal line of pipe to carry away the water collected

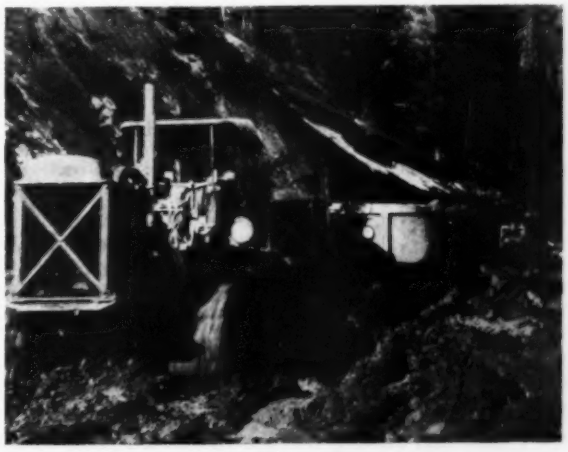


Showing How Ballast is Forced Below the Natural Ground

from the pockets. In one such situation this difficulty would have been presented if it had not been for the presence of a deep ditch nearby. At this point, the pockets were as deep as eight feet, which made the bottom as much as four feet below the natural ground. The expense of stabilizing this fill was naturally greater than what it would have been if the drains had been installed before the pockets had developed to such an extent. In cases where fill heights are great enough to prevent pockets from reaching the natural ground level, they often develop to a surprising depth.

Experience with many conditions of poor drainage such as those described above has led to the conclusion that no two situations involve the same conditions and, therefore, that the remedies to be applied will vary accordingly. For this reason it is essential that a thorough investigation of the conditions at the troublesome location be carried out before an attempt is made to select and apply a remedy.

All the investigations referred to above were made by the Ingot Iron Railway Products Company, Middletown, Ohio, and most of the installations were made by the subsidiary contracting organization of this company, under the direction of the various railway engineering organizations.



Moving Earth with Tractors on the Western Pacific's New Line in California

A Complex Layout
The Four-Track B. & O. Line Crosses the Yard Tracks in the Foreground, Passes Through Two Arches in the North Avenue Viaduct and then Over a Branch of the Pennsylvania on a Bridge Seen in the Background. Below the B. & O. Tracks and in a Location Directly Under the Viaduct Is a Tunnel that is Occupied by the Pennsylvania Main Line to Washington

Working in Close Quarters

Restricted clearances on B. & O. necessitate half-through spans and chipping of masonry

By P. G. LANG, Jr.

Engineer of Bridges, Baltimore & Ohio, Baltimore, Md.

TRAFFIC congestion, when coupled with a multiplicity of tracks and structures within restricted space in highly developed metropolitan areas, introduces many extremely difficult problems of railway operation and construction. Such a condition was strikingly illustrated recently on the Baltimore & Ohio when it became necessary to renew two bridges in the midst of highly complicated and restricted surroundings, where the problem was to construct the new bridges within well-defined limits both above and below the tracks.

Three Railroads and a Street

The northern railroad approach to the city of Baltimore, Md., is characterized by the crossing at one point of the three principal lines serving that area, while, at the same point, all of these railroads are intersected by one of the city's main avenues. North avenue is the thoroughfare in question and extends in an east-to-west direction, being at this point conveyed across Jones Falls by means of a stone arch viaduct.

The four-track line of the Baltimore & Ohio passes through two arches in the street viaduct, there being two tracks in each arch. Immediately beneath the B. & O. tracks, and passing through the arched piers of the North avenue viaduct is a railroad tunnel in which are situated the tracks of the Pennsylvania line extending between Washington, D. C. and New York, which tracks at this point are also used by the Western Maryland. It is obvious from the foregoing brief description that the clearance conditions are extremely restricted, and that there exists slight possibility for improvement.

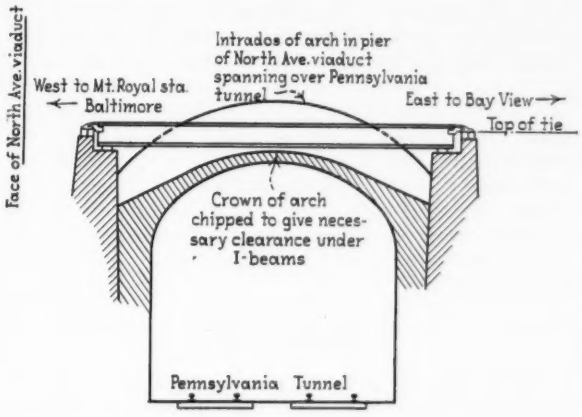
Old Structure Built in 1893

The original bridges carrying the tracks of the B. & O. across the Pennsylvania tunnel at this point were through plate-girder structures, built in 1893, with girders 4 ft. 6 in. in depth. The distance from the base of rail to the extrados of the Pennsylvania tunnel underneath the bridges was approximately two feet, and the vertical distance from the base of rail of the B. & O. tracks to the intrados of the arches of the North Avenue bridge was 20 ft. 6 in. The total lateral clearance of each of the latter arches is 29 ft. The flanges of the girders between and on each side of the tracks prevented the passage of engines having wide or low cylinders, and, with the passage of time and the accompanying growth in the dimensions of motive power, this situation had become increasingly serious, from the standpoint of both traffic and operation. Further, the old bridges were of a light and obsolete type, having a rating materially below the rated capacity of the line, and were subjected to a permanent operating slow order.

Under the conditions described, the desirability and also the difficulty of replacing the old bridges with modern bridges of such a design as to improve clearance conditions are apparent, and, with this desideratum in view, the situation was a subject of careful study. Restricted by physical conditions which prohibited any material change in the track level or the extension of the structures in either direction, the designers were confronted with a problem which made exceptional demands upon engineering resource and ingenuity.

Adopted Design Has Special Features

The design finally adopted was that of a half-through I-beam type, with beams 38 ft. long, 30 in. deep and weighing 220 lb. per foot. Actually in this structure each rail is independently supported on what has the characteristics of a miniature through plate-girder span, in which the 30-in. girder beams constitute the main members. This analogy is further sustained by the use of diaphragms having 2-ft. centers and composed of 15-in., 42.9-lb. I-beams, which serve the purpose of small floor beams. On these cross beams and longitudinally to the line of the structure are placed white oak stringers, 7½ in. by 16 in. These stringers are placed with the greater dimension horizontal, and are fastened to



A Cross-Section of the Tunnel Showing Its Relation to the B. & O. Bridge

the 15-in. I-beams by means of continuous 5-in. by 3-in. by ½-in. angles. Upon these white oak stringers the rails, which rest on canted tie plates having 1-ft. ⅛-in. centers, are supported.

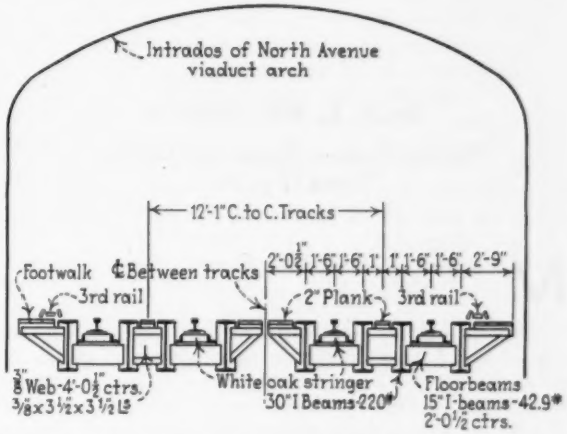
As these bridges are situated on the main line, in the Baltimore Terminal district, they are subjected to the movement of electric motive power units as well as steam. In fact, the line has a peculiar historic distinction, as it was here, on June 27, 1894, that electric traction for the movement of heavy trains, and especially as a means of abating the smoke nuisance, was first tried, with results which justified its immediate and permanent adoption.

In connection with the use of electric traction, a third rail of the ordinary type extends throughout this territory. At these bridges, however, owing to restricted clearance conditions, it was necessary to provide a special type of support for the third rails. Also, as the conditions of terminal operation require the frequent stoppage of trains at this point, it was necessary to equip the bridges with footwalks. As a result of these various factors, the bridges are completely planked over.

It is worthy of particular notice that, while the spans of the new bridges are of the unique character described and are designed to meet extraordinary conditions, the bridges are strictly modern in all respects, including carrying capacity, as they are designed for E-60 loading and are capable of carrying any motive power or rolling stock now in use.

Inches Were Precious

As this article seeks to emphasize, space at this point is so precious as to justify extraordinary measures to obtain an extension in any direction which could be expressed in fractions of an inch. For the bridge seats, a very hard variety of granite was used. A slight lowering of these bridge seats was effected by chipping, which



Cross-Section of one of the Bridges over the Pennsylvania Tunnel

was an extremely difficult and tedious process, owing to the nature of the material and the restricted working space. To provide the clearance necessary for the new bridges, particularly when deflection was taken into account, it was necessary also to chip slightly the extrados of the arch beneath the structures.

As previously stated, the B. & O. line at the point where it passes beneath the North Avenue viaduct, and for a short distance on each side of that crossing, consists of four tracks, this section terminating at each end in a two-track line. The existence of these four tracks, passing through two separate arches of the street viaduct was of advantage in devising the erection procedure. After all preliminary arrangements had been made, including the field painting of the new span, traffic on two tracks was abandoned, the existing structure for these two tracks removed and the new structure placed, whereupon traffic was restored over the tracks affected, and, at a later date, the process repeated for the remaining two tracks. The work of erection, in all of its phases, was carried out by company forces, with no interference with traffic and without accidents of any character.

FIFTY YEARS AGO.—During the past two years the mileage of narrow-gage roads in the United States has increased from 4,188 to 5,962 miles. Within the same period narrow-gage roads having a mileage of 667 have been either changed to standard gage or purchased by standard-gage companies which are about to change them. The narrow-gage lines thus far constructed in the United States total 6,629 miles, or about 7 per cent of the total railway mileage of the country. This mileage embraces 149 roads.—*Railway Age*, April 21, 1881.

Eliminating the Hazard in Power Equipment*

A discussion of precautions to be observed in the use of modern maintenance of way machinery

By A. E. WILLAHAN
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Avoid Accidents in Work Train Service

MACHINES have come to stay and will increase in number rapidly. Our safety problem, therefore, has become one of devising ways and means of using them efficiently, with minimum injury and loss of life. I have, during the past 10 years, had the opportunity to observe in action most of the machines now in use by railway maintenance of way departments. Where my own field has lacked detail, many of my friends have supplied me with data and with facts from their own experiences.

During the past decade, more than 20 machines for doing various types of maintenance work have been developed. Some have a single function, while others are adapted to a variety of uses. It is obviously impossible to cover each machine in detail and for this reason I will refer only to those that are causing the greater number of accidents.

Excavating Machinery

The most fruitful cause of accidents charged to excavating machinery is the falling of either a part or all of the load from the dipper, clamshell or bucket. I reviewed a report not long ago of an instance that will illustrate. The accident was caused by the operator of the machine accidentally tripping the dipper latch, causing the load to fall on two men, one of whom was killed and the other seriously injured.

Under-cutting on the working face to the extent of leaving overhanging material is dangerous and yet is is commonly done. The striking of workmen by the dipper or clam-shell bucket is the result of carelessness, yet it happens more often than one would suppose. Frequently, men are injured while making repairs or adjustments to some part of the machine while it is in operation. The remedies for such accidents are obvious. Closer supervision by the man in charge, and a careful machine operator are the most potent safeguards.

The movement of materials with cranes causes a large number of injuries, in which the percentage of fatalities is high. A rough check of the statistics shows that there is one death for each 29 reported injuries. Those accidents that occur most frequently are the result of falling loads, which are due primarily to carelessness in fastening them, poor hitches, improperly designed lifting hooks, faulty containers, slings either not strong enough originally or weakened by the numerous defects that easily escape notice, and reckless handling of the lifting line or boom. We have found that good equipment, with proper inspection and supervision, which includes the instruction of the crane operator and his helpers in the best of safe practices, pay a handsome return in the prevention of accidents.

Handling Rail

The handling of rail is a prolific source of injury. As the weight of rail has increased, the difficulty of handling it manually has led to the design of machinery to do the work. The introduction of mechanical handling has eliminated some of the former hazards, but unfortunately has created others.

A railroad on which injuries in rail-laying gangs were about 20 per cent higher than those on a neighboring road reduced its accidents about 50 per cent by a change in the design of the lifting tongs. The number of broken limbs and crushed hands and feet accruing during the handling of rail may be kept to a minimum by the careful and painstaking instruction of the men who work about the machine, the assignment of men to certain duties, and the use of intelligence in selecting the men. There should also be close and frequent inspection of the parts of the machine subject to excessive wear, which should be the duty of the man in charge.

Most roads have an assortment of devices for shaping the subgrade and ballast sections. By virtue of the nature of the work done, these machines are heavy in design and require the application of considerable power. Various parts of the machines are adjustable and call for special care if they are to be operated safely. Rapid changes in the position of wings or blades sometimes catch a man off his guard. When this happens he is usually badly hurt or killed outright.

An accident of this sort once came under my own ob-

*Abstract of a paper presented before the annual meeting of the Steam Railroad Section of the National Safety Congress at Pittsburgh, Pa.

servation. A man was standing within the path of an adjustable blade. The operator applied the air to the piston that swung the blade which struck the man just above the shoulders. He had tried to move, but a loose half sole on one of his shoes caught on a sharp projection, preventing him from getting in the clear.

You will note that there were two causes contributing to this accident. One was the lack of proper instruction as to the direction of movement of the blade and the other was the dangerous condition of the man's shoe. One of the best safeguards is the employment of physically active and mentally alert men. These men should be carefully instructed in safe practices and should be thoroughly familiar with the operation of each part of the machine. After satisfactory men have been secured, there should be as little change in the personnel as conditions will permit.

Tie Tamping Equipment

Machines for tamping ties are being used in large numbers by railroads. Some of the machines are direct acting, being operated by two or three men, while others are operated electrically or pneumatically. In the case of the two mentioned last, the actual work is done with a hand tool weighing from 20 to 40 lb. In connection with the use of this equipment two serious accidents, resulting in the death of nine men, were reported last year. The underlying cause of these accidents was improper flagging in one instance and a disregard of the flag by the train crew in the second case.

A mechanical adzing device is being widely used. Owing to its rapidly revolving cutting head, this machine has caused numerous eye injuries from flying chips. To remedy this condition, safety-guards have been applied to the cutting head, and as a further precaution, the men working nearby are required to wear goggles. After he has lost his sight, it is too late to caution a man to wear his goggles. Therefore, definite instructions should be given the men to protect themselves and if necessary suitable discipline should be applied to enforce this rule.

Welding Machines

A few railroads have adopted the practice of building up battered rail ends by the process of arc-welding. The use of electricity introduces an additional hazard of accident. While the voltage used is not extremely high, there are certain conditions when a man can be dangerously shocked, as when the resistance of the body is low. Perhaps the greatest care should be taken in the use of the grinder. Poor grounding and defective feed wires have accounted for several reported cases of shock.

Eyes must be protected from the injurious rays generated by the arc, and when using the grinder there is constant danger of eye injury from flying particles of metal and dust. The welders are provided with suitable helmets and the other men are equipped with goggles. It is an open question whether constant use of the electric arc has an adverse effect on the eyes. The suggestion has been made that workmen be rotated at suitable periods and given some other kind of work as a means of resting the eyes.

Weed-destroying equipment is employed on most roads. One method of destroying weeds utilizes heat and another makes use of chemicals. The burners develop high temperatures and, as minor adjustments and repairs are frequently necessary, cases of severe burns are encountered. The usual first-aid kits are carried on these outfits and emergency relief is given. However, subsequent lack of care, resulting in infection, has caused permanent disability.

In handling solutions of arsenic, extreme care should be taken to remove it from the skin in the event of contact. The poison is insidious and no immediate effect may be observed. We had a case of foot infection when a man walked about the machine in the wet grass. If the proper attention is not given at once, fatal poisoning may be the outcome. To avoid burns or poisoning is a matter of ordinary intelligence and yet we have constant repetition. The careless handling of gasoline from tank cars to the storage tanks on weed-killing machines has been the cause of more than one disastrous explosion.

The Greatest Hazard

All of the machines considered are of such weight that they must be moved from place to place on the tracks. Most of them occupy the track while they are being used. If I were asked the question, "What constitutes the greatest hazard?" I would say, "train operation."

The hazard of accident becomes greater as railroads expand from single to multiple tracks and the traffic density increases. Rules governing the movement of work equipment are in effect and are strictly enforced on every well-managed road, but regardless of the rules we have wrecks entailing serious injury and frequently loss of life. Investigation usually develops the fact that the work gang failed to clear the track, owing primarily to improper flagging or disregard of it by the crew of the train flagged. The high percentage of fatalities resulting from such accidents, which is about 15 per cent, places this hazard in the front rank.

Shortly after we had begun the use of our rail welder a man was killed. The facts brought out were that he had put his foot on the rail and was intent on tying his shoe lace when a passing train struck and killed him. The investigation showed that the engineman had blown his whistle and that the vision of the man was not obstructed, yet he did not hear the approaching train. Why?

As one of the contributory causes, he was standing near the generating unit driven by a gasoline engine. All of us have experienced the deafening effect of the explosions from a motor running with the cut-out open. Within a certain radius it is very difficult to hear any other sound. The human ear is a delicate mechanism, receiving vibrations and recording them in the brain as sound. There is a very definite limit to its capacity to receive and record, and when this limit is reached it ceases to function. After this accident, the road with which I am connected took steps to equip engines of this sort with devices that practically eliminate noise.

Are Machines Safer?

The question confronting the railroads is: Can track work be done with a machine with less injury to the men than with strictly hand methods? The answer is "yes"—because it reduces man-hours. But we must first recognize the inherent hazards of each type of machine used, and then do everything humanly possible to eliminate them. There are several advantages in our favor. These include the smaller number of men involved, the higher grade of intelligence of the workers, and better organization. We have proved to our own satisfaction that this is true. The road with which I am connected has one or more of each of the machines I have discussed. Our safety records show that as mechanical means for doing track work have expanded, our injuries per million man-hours have been consistently decreasing.

Jack 68-in. Pipe Under Fill

Installation of nine precast flat-bottom culvert sections broadens application of tunneling method

The Size of the Pipe Facilitated Excavation and Spoil Removal

WITHIN the last few years the jacking method has attained wide use as a means of installing small and medium sizes of pipe under railway embankments, but its use was not extended to the installation of larger sizes of concrete pipe until recently when, by this means, nine 8-ft. lengths of 68-in. by 68-in. Massey precast flat-bottom concrete pipe were installed under a double-track embankment of the Terminal Railroad Association of St. Louis. This installation was made to provide an underpass for a number of large pipes of the Phillips Pipe Line Company, which were hung from the walls of the concrete pipe by means of racks.

Sections Weigh Nine Tons Each

This size of Massey pipe has an over-all width of 7 ft., an over-all height of 7 ft. 2 in. and each section weighs 18,400 lb. Owing to the size, weight and shape of the sections and also to the unseasonable weather that was encountered during the installation work, the insertion of the pipe was attended by a variety of problems.

The embankment in which this installation was made has a height of about 8 ft. over the top of the pipe. On one side it consists to a large extent of heavy limestone boulders which extend to a distance of 15 or 20 ft. under the embankment. Because of these obstructions the installation of the pipe was commenced from the opposite side of the embankment.

Preliminary to the actual work of installation, a three-rail storage skid for the concrete sections was constructed at right angles to the center line of the pipe and on a three per cent grade downward to the jacking platform. A short level skid, also consisting of three rails, was constructed on the center line of the pipe on the opposite side of the embankment, as it was planned to install two sections of pipe from that side.

The jacking platform consisted of 7-in. by 9-in. switch ties which were securely anchored to mud sills. On the side of the platform opposite the storage skid, a frame guide for the concrete sections was erected at about half the height of the pipe. The platform was constructed so as to allow space for the passage of two 3-in. by 10-in. smoothly-finished fir timbers which extended into the embankment under the pipe and acted as bearing guides for the installed sections. These timbers were well oiled and were jacked forward by means of track jacks bearing against the rear timbers of the jacking frame. Their forward ends were maintained at a distance of from 15 to 18 in. ahead of the pipe.

The concrete pipe was jacked forward by means of two 50-ton Buda jacks arranged in a horizontal position parallel to each other. The jacks were braced against the backstop of the jacking platform and the pressure was transmitted to the concrete pipe through a timber frame which was designed to distribute the load evenly over the end of the pipe. This frame was shaped in the form of an L, with the long leg in a horizontal position and the short leg bearing against the end of the concrete pipe. The horizontal portion of the frame consisted of two 12-in. by 14-in. timbers, each of which was directly in line with one of the jacks. The vertical portion of the frame consisted of two 12-in. by 12-in. timbers tied together at the top by means of an 8-in. by 8-in. member. The vertical timbers reached to the bottom faces of the horizontal members and extended up along the ends of pipe side walls. The frame was strengthened by two 12-in. by 12-in. inclined timbers that made an angle of about 30 deg. with the horizontal members and contacted with the vertical members at about their middle points.

The Pipe Sections Were Stored on a 3-Rail Skid Laid on a 3 Per Cent Grade Downward to the Jacking Plant

The excavation was carried ahead of the end of the forward section of the pipe for a distance of about three or four feet to form a working chamber in which the men were protected from possible cave-ins by an overhead shield that projected two feet ahead of the pipe. This shield consisted of No. 10 gage sheet steel that lapped over the end of the pipe a distance of two feet and was wide enough to cover the full horizontal projection of the pipe. It was reinforced on the underside by 1½-in. T-irons placed in a horizontal direction and by an angle iron at each end that was curved to the contour of the pipe. These reinforcing members were fastened to the steel sheet by welding. The shield was secured to the concrete by three bolts near its rear end.

The excavating was done with hand tools, the spoil being removed from the pipe and dumped on each side of the platform by means of wheel-barrows. The size of the pipe and the working chamber afforded sufficient space for the use of sledge hammers and bull points for loosening the boulders. When these obstructions were encountered underneath the pipe they were removed to a depth of from six to eight inches below the bottom surface of the concrete, this space being backfilled with clay. The tunnel was made large enough to clear the top and sides of the pipe by about two inches.

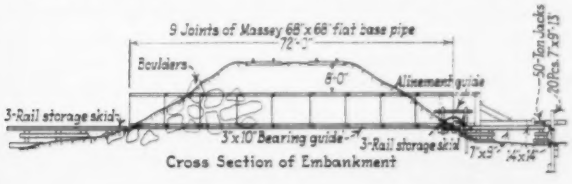
The rails of the pipe storage skid were well oiled to facilitate the handling of the sections from the skid to the jacking platform. In addition, a hand hoist was provided on the side of the platform opposite the skid, by means of which the sections of pipe were pulled from the skid and placed in position on the platform. The sections were unloaded from the cars by means of eye-bolts, one of which was inserted in a hole in the top of each section. Each eye-bolt extended entirely through the wall of the pipe and also through a metal plate that was provided on the inside as a protection against crushing the concrete.

It was planned originally to insert seven sections of the pipe from one side of the embankment and to place the remaining two sections from the opposite side. In the course of the work, however, a 24-hr. rain occurred which softened the ground in this vicinity to such an extent that the backstop of the jacking platform failed and had to be reset. Owing to the weakened condition of the backstop it was necessary to transfer operations to the opposite side of the embankment after the sixth section had been jacked in place.

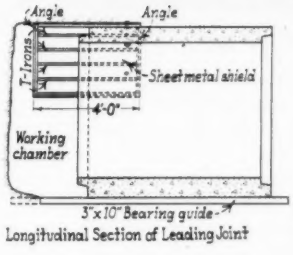
Had normal weather obtained throughout the installation it was thought that seven and perhaps all nine of the sections could have been jacked in place from one side of the embankment as the work was progressing without difficulty. The surface and line of the completed installation was better than had been anticipated, the grade varying less than 0.2 per cent from the desired level grade. A settlement of only from 2 to 2½ in. was noted in the tracks after the installation and the grade was restored by two small lifts. Only eight days were required to make the installation from the time the jacking was commenced until the final work was completed.

The jacking method of installing this pipe was chosen because it was found to offer several advantages as compared with pouring the concrete in place or installing the pipe by open excavation. Interruptions to traffic and the necessity for extensive shoring and excavation under the double-track line were eliminated. In addition, by utilizing the jacking method it was thought that any trouble rising from a soft place in the track at the point of installation would be precluded. The complete cost of the project represented a saving of between two and three thousand dollars as compared with bids for the installation of a 6-ft. by 6-ft. concrete box, which would have required a temporary supporting trestle.

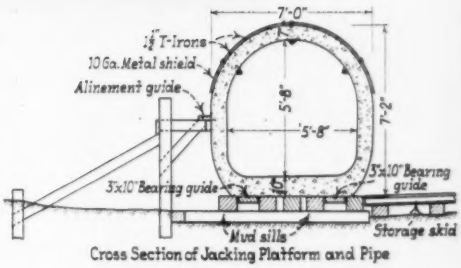
We are indebted for the information contained in this article to D. C. Bowman, engineer and contractor, St. Louis, Mo., who had the contract for supplying and installing the pipe. The concrete pipe was manufactured by the Massey Concrete Products Corporation, Chicago.



Cross Section of Embankment



Longitudinal Section of Leading Joint



Cross Section of Jacking Platform and Pipe

Upper Left—A View of the Jacking Platform and Jacking Headframe. Upper Right and Lower Left—General and Detailed Sketches of the Method of Jacking. Lower Right—Looking Through an Installation of Concrete Pipe in a New Fill at the Jacked Installation in the Background

Putting Permanency into Weed Killing

Proper quality and quantity of chemical and time of treatment found important in achieving best results

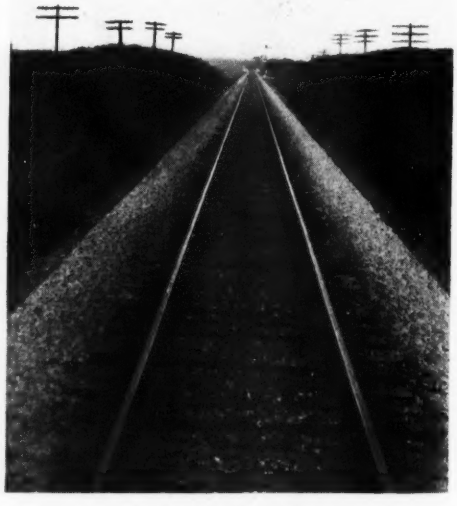
By W. H. CLEVELAND

General Track Inspector, Atchison, Topeka & Santa Fe, Wellington, Kan.

THE eradication of vegetation from railway tracks and roadbed by the use of chemicals is becoming an almost universal practice. The economy and other advantages of this method as compared with hand cleaning methods are now recognized by many large railways, although some of them are still applying the method experimentally. Experiments, of course, never cease, and are the stepping stones of progress, but while a process is still in the experimental stage the full economy sought for is delayed until experience indicates the practice that will give the best results.

Each season during the past ten years the writer has been actively engaged in the application of chemical weed killer to track comprising all conditions of roadbed, soil, vegetation, climate and altitude. In the following are set forth some of the conclusions drawn from this experience.

Each growing season an abundant crop of vegetation is produced on the track and roadbed and this crop multiplies in density each season as the ballast becomes permeated with wind-drifted soil and stock car droppings. Hand cleaning serves only to fertilize the soil and this condition is augmented by the weed seeds that are deposited on the roadbed by the fall and winter winds. Even if the track is kept perfectly free of vegetation during the season, the seeds that are deposited on the soil and ballast by the wind result in a thick growth the following season. This is true with any method of weed destruction that does not sterilize the soil. There are some methods of destroying vegetation by the use of heat which are more economical than and preferable to hand cleaning.



This Track Received No Treatment Between December, 1929, and the Fall of 1930, When the Picture Was Taken

Cleaning vegetation from the roadbed and especially from ballasted track is a heavy annual expense, particularly if performed by hand methods. The greatest economy and the most satisfactory results are obtained through the use of chemicals that will destroy the vegetation and sterilize the soil, thereby preventing annual plant regrowth the following season. To accomplish this end, a sodium-arsenite solution has proved to be the most economical, permanent and satisfactory remedy within the range of conditions imposed in the territories under my observation. It must be properly distilled, mixed and seasonably applied in the proper quantities, which should vary according to the density and variety of the vegetation, the condition of the soil and the climate encountered.

Sodium-arsenite is a distillation of arsenic broken down and held in solution with caustic soda. The mean formula commonly used is 4 lb. of white arsenic and 1¼ lb. of caustic soda per gallon of the concentrate. When applied for killing vegetation it is diluted with water. The solution most commonly used is 1 in 16, i. e., 1 part of chemical and 15 parts of water. Before being applied, the solution is mixed thoroughly by agitation. It is deposited on the roadbed through spray pipes.

The spray pipes should be equipped with quick-action valves, so that the application of chemical can be made in both extra heavy and minimum quantities and the change from one to the other made instantly. With this arrangement, the operator can reduce the application on areas of light growth and increase it to the extra-heavy application on areas of dense and hardy growth, thereby obtaining the proper distribution to secure the greatest economy and best results. The speed of application should never be greater than that which will permit the solution to be absorbed in the soil within the limits of the area desired to be treated, as any chemical that flows outside this area is wasted. Embankment slopes should not be chemically treated as a growth of vegetation on them retards the washing and scouring of the soil.

Higher Causticity Found Best

Years of experience have indicated that 1¼ lb. of caustic soda per gallon of chemical is not sufficient to secure the best results. A mean formula of 4 lb. of white arsenic to 1½ lb. of caustic soda is preferred. These proportions give better results and quick action. The arsenic is carried into the hardy plants quickly and permanently.

and the adverse results of wash when rain follows the application within a few hours are prevented to a great extent. Slow penetration and inadequate action are the results of light causticity. During the past several years, the writer has applied various formulas, ranging from 1.2 lb. to 2.0 lb. of caustic per gallon of concentrate, and has found that the high causticity gives the best results. The mean formula should not be less than 1½ lb. of caustic soda and 4 lb. of arsenic per gallon.

To obtain good results generally, a fixed amount of water should not be used exclusively. Although a solution of 1 in 16 is commonly applied, it does not meet the requirements of all conditions. The degree of dilution should vary according to the weather, the condition of the soil and the density of vegetation. In cases where the soil is moist from a recent rain, and the vegetation is not too dense, a mixture of 1 in 16 or even 1 in 14 will prove effective. However, where the vegetation is of a dense, rank growth, the weather hot and the soil very dry, the mixture should be 1 in 18 or 1 in 20. Where these conditions exist to a severe degree, a mixture of 1 in 22 or 1 in 24 should be used in order that the vegetation shall be thoroughly drenched and the soil well saturated with the solution. Chemical of high causticity permits the use of a larger quantity of water without destroying the good caustic effect of the solution.

This Photograph Was Taken Nearly a Year After the Chemical Was Applied and No Hand Cleaning Had Been Done

Penetration Necessary

The most effective results are gained when the solution is deposited in such a manner that the chemical is carried down to the buds and the shallow surface feeders of the plant. The soil should be fully sterilized so that seed germination within the treated area will be prevented during the following season. The chemical is carried into the soil only as far as the water penetrates and is liberated at that depth. If the plant growth is dense and rank, and the soil very dry, a mixture of 1 in 16 will be absorbed in the foliage of the plant and on the dry surface of the soil, crystalizing after very little soil penetration.

Annual plants of the soft fleshy varieties are easily killed, but the hardy and perennial growths cannot be eradicated solely by burning or poisoning the foliage. The capillary circulation will partake of the chemical, causing the foliage to wither and die, but the plant feeders and buds will live to grow again. On the other hand, when the surface feeders of the plant absorb the chemical it is circulated throughout the plant, thereby causing its destruction.

A chemical of high causticity will permit the use of an increased volume of water, still retaining sufficient caustic effect, with the added advantages of quick penetration. Rapid crystalization is retarded, thereby extending the period of absorption in the soil so that the chemical may reach the feeder roots of the plants. Cut off or burn a perennial plant and it will multiply, but eliminate pure root nourishment and the plant will die.

Season is Important

The proper seasonal treatment and the amount of chemical applied are highly important factors in the economical eradication of vegetation. Years of experience show that the best results are obtained when the chemical is applied in the late summer or fall. When vegetation is killed early in the season, the dead stalks remain standing until broken down the following winter. To remove dead vegetation that has been killed early in the season removes a certain per cent of the virtue of the chemical that had been absorbed in the dead stalk. Furthermore, chemical applied in the early or medium early part of the growing season is subject to the effect of the summer rainfall and the neutralizing influence of the sun. It must also combat all the seasonal efforts of nature to produce plant growth. Under these influences a plant that is partly killed revives and continues to grow. Much better results are gained from the application of chemical in the late summer and fall at the time the plants have matured, and the season of vigorous growth has terminated.

The solution is deposited directly on the soil, and penetrates slowly into it during the fall and winter. It reaches the plant roots and seals the soil surface with a chemical sterilization that prevents annual plant growth the following spring. When the treatment is followed by another application the following season, plant growth is practically eradicated, and seeds that have been deposited on the roadbed will not germinate in the treated area. Arsenic, being a soil element, will not be seriously affected by the winter weather.

An Experience on the Santa Fe

An example of the effectiveness of late chemical treatment is afforded in an experience on the Western lines of the Santa Fe, during the 1929 weed-killing program. Forty-two track miles of main line that had been ballasted with crushed rock several years before were resurfaced with new rock ballast and the embankment rebuilt. This track was on the program to be treated with chemical weed-killer after the ballasting program had been finished. Owing to various interruptions, there were 29 miles of this track on which the ballasting had not

been finished when the chemical was applied in July. The 13 miles that had been completed were treated during that month and the sodium-arsenite was held in the tank car in preparation for treating the additional 29 miles of track as soon as it could be finished.

Adverse weather conditions delayed the application until December 6, when, after several snow squalls and light freezing, the weather and soil conditions became favorable. No vegetation had started to grow on this length of track and the soil absorbed the chemical nicely. The mixture used was 1 in 16, and 2,800 gal. per mile was applied over a width of 20 ft. The results of this late treatment were very gratifying as there was no regrowth of annual plants in 1930, and not more than a 1½ per cent regrowth of hardy perennial plants, although this location embraced territory in Kansas and Oklahoma that had previously produced a rank growth of vegetation.

This application gave the best results that we have yet attained and after further light sterilization to fortify the chemical, additional treatment can be omitted indefinitely. Other locations treated in late September show results that are very satisfactory. In the treatment of track that has been ballasted shortly before the commencement of hardy plant growth, the application of the chemical gives very satisfactory results.

The Track in the Foreground Was Treated in December, 1929 While That in the Background Beginning at the Semaphore Was Treated in July, 1929. The Picture Was Taken Last Fall

Various Factors Determine Quantity

The quantity of chemical used per mile of track has much to do with economy and the permanency of the results. It should be governed by the general condition of the soil and the variety and density of the vegetation. As compared with heavy applications, there is no economy in making light applications. Light and medium applications where the vegetation consists of some hardy and perennial plants will necessitate the treatment of the roadbed each season, with the hardy plants surviving. Since work-train service is an item of heavy expense in the application of chemical to the roadbed, its elimination will effect a considerable saving. Heavy applications of chemical for two or three years will eradicate the vegetation and sterilize the roadbed, and such track can then be released from further treatment indefinitely, thus eliminating several years of work-train expense.

The economy and after benefits derived from the use of a chemical weed-killer as compared with hand methods are more than sufficient to warrant its extensive use. Five-year records covering track under widely varying conditions reveal that hand cleaning is most expensive when applied annually. In comparing the two methods, consideration must also be given to the deterioration and damage to the track and roadbed caused by the use of hand methods and the comparative appreciation resulting from the use of chemicals.

The principal objects in using a good grade of crushed ballast are to support the ties and to conduct excess moisture quickly to the subgrade with free egress to the borrow pit. Similarly, the subgrade is sloped from the center to the outer edges of the shoulder so that the excess moisture may pass off. For this reason, the contour of the subgrade and the quality and cleanliness of the ballast must be preserved in order to promote the proper track conditions.

Hand Methods Found Detrimental

The use of hand methods involves the picking of the vegetation from the ballast by hand and the use of shovels and scuffle hoes to scalp it from the exposed subgrade for the desired distance from the toe of the ballast. This method is expensive and also damages the track and roadbed to a certain extent in addition to providing only temporary relief. When once established foul ballast, weeds and grass are not readily pulled out and often are broken off only to grow again. The difficulty of pulling thistles and sand burrs by hand is also a decided disadvantage.

The scalping of vegetation from the subgrade is expensive and damaging and gives only temporary relief. During each performance an appreciable amount of soil is displaced and cast away and the surface of the soil is loosened so that it is subject to washing and wind scouring. This process soon forms a hollow or depression along the ballast line which retains the water that is discharged from the ballast. This moisture, of course, is absorbed by the subgrade, thereby softening the roadbed and resulting in damaged subgrade, rough riding track and increased maintenance costs. The continuation of this process for some time will require the renewal of the subgrade, which cannot be restored fully if the attempt is deferred for too long a time.

Chemical weed destruction, in addition to costing less annually than hand cleaning, is more satisfactory since it acts to preserve the contour of the subgrade and the quality of the ballast. Other advantages are the elimination of the fibrous roots that obstruct free drainage, the reduction of the expense of renewing banks damaged by scuffle hoes and shovels, and the prevention of a soft subgrade due to the same cause. The tendency of these factors is to decrease materially the cost of maintaining the track.

A Typical Extra-Gang Labor Camp

Keeping Labor Camps Free of Vermin

Methods employed by one western road to control rodents and insects in bunk cars and buildings

IN THE operation of such facilities as store houses, commissaries, restaurants, dining cars, cabooses, section houses, laborers' camps, and bunk and outfit cars, the railways are compelled to wage a constant fight against the inroads of rodents and a wide variety of insect pests. Maintenance officers, particularly, are confronted with the necessity of keeping these pests out of laborers' camps and bunk car outfits, and, frequently, their efforts meet with only indifferent success.

Methods of eradication differ somewhat on various roads, but two difficulties are always experienced in every effort to obtain complete control. One of these is that, because of their small size, these pests are able to hide in the most inaccessible places. The other is the fact that, although they may be exterminated, fresh invasions are almost certain to follow.

Extermination Methods Are Successful

One large western road has had unusual success in controlling both types of pests in its camp outfits, so that a study of the methods it employs is of interest. For four years it has used Calcyanide in its annual campaign to eradicate rodents and other vermin from its bunk cars, kitchen and dining cars, commissary cars and other equipment of similar character, as well as from the fixed camps which it maintains for laborers.

Fumigation is ordinarily carried on during the months of April, May and June, and occasionally during July and August. In order to insure that the eradication will be complete, every car or building is fumigated twice, the second dosage being applied about 10 days to 2 weeks after the first. If a second invasion should occur during the season, these applications are repeated.

The second fumigation has been found necessary because it is almost impossible to reach every individual or insect egg with a single application. The reason for this is that, in the types of cars and buildings usually employed for camp purposes, it is impracticable to eliminate all of the minor openings in the walls of these structures. Air entering through these openings from the outside dilutes the fumigating gas in the immediate vicinity, so that any vermin within the area of this dilution usually escapes destruction.

If practicable to avoid it, fumigation is not undertaken at temperatures below 70 deg., for the reason that most insects become inactive below this temperature and many of them are dormant at 55 deg. or less. If the fumigation is carried out below 70 deg., it is probable that some individuals will escape, even in the tightest structures, while at 55 deg. or below, it is likely to be wholly ineffective. It has been found that the best results are obtained at temperatures of 80 deg. or higher. Fumigation is not attempted on windy days, since leakage of the gas occurs in even the tightest structures.

Preparation for Fumigation

In general, the period of exposure is three hours, although certain insects, such as moths and cockroaches, require an exposure of about four hours. In passenger or other tightly constructed cars, all that is necessary is to close all windows and ventilators for sealing. In outfit cars more preparation is required to prevent air leakage, for to secure maximum results the space must be sealed as completely as practicable. After the windows are closed, papers or sacks are stuffed into the stovepipe, all exterior cracks and crevices are sealed and broken window panes are covered by means of paper applied with a flour and water paste.

Experience has shown that it is unnecessary to remove or disturb any of the contents of the cars or buildings, since the gas generated by the Calcyanide has no harmful effect on metals, wood, fabric or foodstuffs. Closet and cupboard doors are opened to facilitate the penetration of the fumes. Inside openings and crevices are not closed, since they facilitate the dispersion of the gas into the walls and hiding places of the vermin. As soon as they smell the gas, both rodents and insects are inclined to come out from their hiding places in an effort to find better air, and thus they do not die inside the walls of the structure.

After the period of fumigation is completed, all doors and such windows as can be operated from the outside

are opened for at least 30 min. before the room is entered for the purpose of opening the remaining windows. On a still day, a longer time may be required. No person is allowed to remain in the room until the odor of the gas can no longer be detected.

Since the material comes in the form of a dry powder which releases hydrocyanic-acid gas upon exposure to the air, it is customary, in preparing for the fumigation, to lay newspapers on the floor and sprinkle the powder upon them. After the room has been aired thoroughly, the papers containing the residue of the powder are rolled up carefully and burned. Considerable caution is necessary in doing this, however, to avoid breathing the dust, since it is very irritating to the mucous membranes of the respiratory passages and of the eyes.

Safety Precautions Are Observed

While the fumigation is in progress, a guard is left on duty during the entire period of exposure and ventilation. All entrances are locked and, as an added precaution, placards are displayed at every door, warning against attempts to enter. After the preparations are complete, but before the powder is spread, a thorough search is required, particularly of sleeping quarters, to insure that no one is left in the room that is to be fumigated, or in any other part of the building.

Fumigators are forbidden to spread the powder or open buildings after fumigation, unless an assistant is present. While engaged in their work, they are required to carry a bottle of ammonium salts in a pocket where it will be easily accessible. Hydrocyanic-acid gas has a distinct and easily recognizable odor, which they are taught to regard as a definite danger signal. This odor is not easily detected, however, if the sense of smell is impaired. For this reason, operators who have colds or are suffering from other disabilities which affect their sense of smell, are not allowed to engage in fumigation work until they are restored to normal physical condition. Because of the extremely poisonous character of the gas, persons untrained in the handling of this particular product are not permitted to use it.

In concentrated form, hydrocyanic-acid gas is one of the most powerful and quickest acting poisons known. In more dilute form, it requires an appreciable time for reaction, which varies with the degree of dilution. Because of its virulence, definite instructions have been issued not to stand in the draft which emanates from the room during the period of ventilation.

Prolonged contact with this gas, even when well diluted, is likely to produce a headache or feeling of dizziness. Since the inhalation of ammonium salts acts as an antidote, fumigators and their helpers are instructed to get into the open air and inhale the ammonium salts immediately upon feeling any effect of contact with the gas.

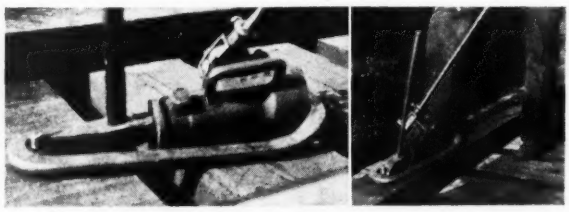
Fumigators are required to make a report in triplicate of each camp or other facility visited. In this are shown the location and character of the facilities fumigated, the variety of pests found, the dosage and the period of exposure. Copies are sent to the engineer maintenance of way and the division engineer, while the third copy is retained by the operator.

This road reports that through constant and systematic attention to this detail of camp management, it has been able to keep its labor camps practically free of pests and vermin. While other forms of insect life are encountered from time to time, those that are exterminated in greatest numbers are roaches, ants, bedbugs and moths, and almost every camp has at some time harbored rats and mice.

A New Way to Cut Nuts

AN INGENIOUS device for cutting the ends off bolts and splitting nuts on bridge decks is in use on the New England lines of the Canadian National. This device, which was developed by C. Bisonnette, bridge and building foreman on this road, consists primarily of a specially designed shackle. The remainder of the equipment which makes up the assembly comprises a standard 10 or 15-ton bridge jack and a track chisel.

It will be noted by reference to the illustration, that the end of the shackle which receives the foot of the jack is bent up enough to loop across the center of the base, thus insuring stability to the assembly when pressure is applied to the chisel by the jack and eliminating



Method of Assembly and Operation

the probability that they will buckle and kick out. It has been found in practice that one man can operate the device and split the nuts for opening up a bridge deck much more quickly than it can be done with a hack saw or a cold chisel and hammer.

Since jacks of these capacities and chisels are part of the standard equipment of bridge gangs, the shackle is the only special part required. Paint gangs have used the device to advantage in opening up bridge decks to clean and paint girders and stringers, when nuts have been riveted on hook bolts or have become so badly rusted that they cannot be turned.

We are indebted to H. Toms, bridge and building master, Richmond, Que., for the information from which this article was prepared.

On the Delaware, Lackawanna & Western

WHAT'S THE ANSWER?

Have you a question you would like to have someone answer? Have you an answer to any of the questions listed here?

To Be Answered in the July Issue

1. What are the relative advantages and disadvantages of spring-rail and rigid frogs for main-line service with respect to riding qualities and economy of maintenance?

2. When applying membrane waterproofing, what determines whether 2-ply or 3-ply should be used for any given structure?

3. Where a sod line is maintained on the shoulder of the embankment, should it be at the toe of the ballast or some distance from it? If the latter, how far? Should this distance vary with different kinds of ballast?

4. How can a water meter be tested for accuracy in the field or in the water-service shop?

5. When relaying with new rail of heavier section, if the base of the new rail is not more than 5/8 in. wider than that of the old rail, should the old rail be lined to wider gage in advance, or should the new rail be laid on one side of the track against the outside spikes and the gage be corrected when the opposite side is laid?

6. Should pile heads that are to be used as foundations for frame buildings be returned to the treating plant for treatment or retreatment? Why?

7. How should a section gang of six to eight men be organized for renewing ties?

8. When repainting steel bridges, to what extent should the old paint film be removed? What is the best method of doing this?

Power Tools for Bridge Gangs

What permanent assignment, if any, of power tools to bridge gangs engaged in timber trestle maintenance, can be justified on the grounds of increased economy and larger output per man-hour ?

They Greatly Facilitate the Work

By LEM ADAMS

General Supervisor Maintenance of Way, Union Pacific, Omaha, Neb.

On our lines the principal power tools provided for gangs engaged in timber trestle maintenance are: Timber sawing machines, 24 in.; wood boring machines; jackhammers for driving sheet piles; and portable gasoline-driven air-compressor plants for driving them.

In timber trestle maintenance, the actual working time is confined to the periods between trains, so that on lines of heavy traffic the productive time may be only a small part of the working day. For this reason, time-saving methods are particularly necessary to obtain the maximum output. We have found that the use of these power tools greatly facilitates the work, in addition to which we get a more satisfactory class of work.

Should Be Used in Common

By Assistant Engineer of Maintenance

It is doubtful whether a definite assignment of power tools to all bridge gangs engaged in timber trestle maintenance can be justified. Consideration must be given to the condition of the bridges and the amount of work involved. Generally there are only a few bridges on a foreman's district which require heavy maintenance, the remainder requiring little if any work for which power tools are adapted. For this reason, a single large power plant and a complement of tools which includes one large and one small saw and two boring machines, which can be transferred from one gang to another, may be sufficient for an entire division. In addition, it may sometimes be advantageous to provide a smaller outfit capable of handling one small saw and one boring machine, this outfit also to be used in common.

Handling and placing the timber often consumes more time than its preparation, so that the power equipment is not kept working long enough to earn its carrying charges. By making transfers, as suggested, they may be made to earn a profit on their cost. As an example, we recently had a job of sufficient magnitude to justify the purchase of two power saws. We found two such saws on other divisions, which were idle, and transferred them, thus making the desired saving without additional investment. By programming the work, a schedule for using this type of equipment can usually be prepared which will permit nearly constant use without causing delay to any gang, thus minimizing the amount of equipment required.

Can Be Used to Advantage

By L. G. BYRD

Bridge and Building Supervisor, Missouri Pacific, Wynne, Ark.

Power tools are of decided advantage from the standpoints of economy and increased output per man-hour in timber trestle maintenance. Treated material, such as ties, guard rails, caps and stringers, should be sized and framed before treatment. It is necessary, however, to frame untreated material on the ground and saw off all piles after they are driven. Treated brace timbers and the piling to which they are applied must be bored on the work. For these purposes bridge gangs should be equipped with power saws and boring tools. Such ma-

chines will reduce the labor cost as much as 30 to 40 per cent on a large job.

On a recent job of bridge reconstruction, the structure being 1,500 ft. long and 25 ft. high, a power plant and complement of tools costing $1,800, was provided. The saving in labor for preparing and applying braces was alone sufficient to more than pay the cost of the outfit. To increase the economy of use of such equipment, it is desirable to extend the fields to which it is adapted. By purchasing a small amount of paint-spray equipment, a compressor outfit which is suitable for a bridge gang can be assigned to a paint gang when not in use.

Such Equipment Demonstrates Economies

By Assistant Engineer of Bridges

Our experience indicates that power tools offer opportunities to make considerable reductions not only in the cost of maintaining timber trestles, but also in the cost of constructing permanent structures. Bridge gangs engaged in timber-trestle maintenance or construction should be provided with an outfit of power tools, consisting of a power plant and a full complement of sawing and boring tools, and a full-revolving self-propelled crane. If an electric outfit is used, provision should be made for electric lights for night work or tunnel jobs. Attractive savings are possible in the use of power tools for cutting off piles and timbers, for framing timbers and for boring holes.

A crane of the type mentioned, having a capacity of from 4 to 7½ tons, can be used to decided advantage in wrecking and renewing timber trestles, unloading and loading material and handling it as may be required. Such a machine should be equipped with a clam-shell bucket to care for such excavation as is needed.

Restoring the Roadbed

To what extent should the roadbed be maintained to standard dimensions? When should the shoulders be restored to full height and width and by whom ?

Should be Maintained at all Times

By L. J. HUGHES

Engineer Maintenance of Way, Chicago, Rock Island & Pacific, Des Moines, Iowa.

Every effort should be made to maintain the roadbed to standard dimensions at all times. It is particularly important, however, in advance of ballast renewals and resurfacing. When the shoulders are narrow, ballast is lost and the track is difficult to maintain.

It is necessary to remove material from cuts periodically, and this material, placed on the shoulders, will keep the banks up to standard so far as it can be applied. In sections where there are not enough ditches to be cleaned out, a good method is to build up the shoulders with teams. On light fills, however, section men can often do the work by hand with economy.

The height of the shoulders is important. In the past it has been considered bad practice to raise the shoulders so as to box the ballast. This idea can be carried to an extreme, however. Under some conditions of soil there may be two feet or more of ballast below the ties, and the expense of maintaining a shoulder level with the bottom of the ballast would be very great, while the amount of ballast required to maintain such a section would extend beyond the line of economy. In the western territory, it is generally unnecessary to keep the shoulder of the roadbed lower than 8 in. below the bottom of the tie. Our experience indicates that we can secure satisfactory drainage by following this practice, and that we are able to maintain the line as well as the ballast section more easily, at the same time reducing the amount of ballast required for repairs.

When Narrowing Affects Ballast Section

By F. G. JONAH

Chief Engineer, St. Louis - San Francisco, St. Louis, Mo.

Roadbed dimensions should be maintained to standard dimensions, particularly when ballast is to be installed or renewed, and at any other time when the narrowing of the embankment affects the ballast section. In cuts it is desirable to keep the subgrade to full width at all times to preserve the drainage, keeping the side ditches as far from the center of the track as the standard roadbed section will permit. This work should be done by the maintenance of way forces. There are times when extensive jobs of bank widening can be contracted to good advantage, but for ordinary maintenance the work can be done by company forces.

Can Be Done in Connection with Ditching

By G. STAFFORD

Section Foreman, Canadian National, Rosebud, Alta.

Economic conditions alone demand a roadbed that is maintained to a uniform standard. The roadbed is constantly subject to forms of disintegration which tend to narrow it, including erosion, shrinkage, sloughing, etc. Unless it is maintained to standard dimensions, ballast will be lost, the toe line will be irregular and line and surface will be difficult to maintain. An irregular ballast toe line destroys the good appearance of the track. While an effort should be made, therefore, to maintain standard dimensions at all times, particular attention should be given to this important matter in advance of reballasting.

Much of the work of maintaining a standard shoulder can be done in connection with ditching operations at practically no additional cost. Modern power equipment is making economical methods practicable, which were unthought of a generation ago.

Section Forces Can do Much

By ROBERT WHITE

Section Foreman, Grand Trunk Western, Drayton Plains, Mich.

In my opinion, standard dimensions should be maintained as nearly as practicable, not only for the protection of the ballast and drainage, but for appearance sake, which is more important than is sometimes thought. Restoration is particularly important in advance of ballast renewals, but should not be neglected at other times. Maintaining a sod line is a great help in minimizing the natural attrition of the shoulders, which occurs constantly.

On light embankments and in short or shallow cuts, the section forces should normally be able to do all that is necessary. Much of this work can be done in connection with regular section duties, but wet days early in the spring when other work is not practicable, are particularly suitable. Again, there are often periods late in the fall when a day or two can be taken without interfer-

ing with other work. High embankments, or those that give chronic trouble, often require train hauls, and here the restoration work should be assigned to extra or ditching gangs.

Removing Concrete

What are the most effective and economical methods of removing mass concrete? Also thin, heavily reinforced sections? What are reasonable costs for the different types of structures ?

Cost May Vary Through a Wide Range

By M. HIRSCHTHAL

Concrete Engineer, Delaware, Lackawanna & Western, Hoboken, N. J.

When it becomes necessary to remove a concrete structure, either in whole or in part, both the method to be employed and the cost may vary within rather wide limits. If it is mass concrete taking no load, or from which the load has been released, as a wing wall or an abutment where falsework has been placed to support the existing span, the case is comparatively simple. Holes may be drilled and the mass broken with explosives. If it is impracticable or dangerous to "shoot" a structure, holes can be drilled on 6-in. centers around the perimeter of the mass to be removed and at irregular intervals over its area, after which a hammer, a bull point or a plug and feather may be substituted for the drill, and the concrete hammered or wedged out.

Removing reinforced concrete is often more complicated. Holes should be drilled on close centers, care being taken to miss the bars, which may not always be spaced as shown on the plans. The reinforcing steel can then be burned off, or, if small, cut with a hack saw or chisel. The difficulties and costs depend on so many factors that no general statement is possible. We have done work that cost as low as $3.50 a cu. yd., while in other cases it has been as high as $3.50 a cu. ft.

It became necessary recently to cut openings in a floor in the new Lackawanna freight terminal warehouse at Jersey City, N. J., to accommodate a tenant. This floor is of the two-way girderless flat-slab design and the openings were intended to accommodate chutes to the floor below. A pneumatic drill was applied to the edges of the areas to be occupied by the openings, two in number, but the drilling stopped short of the full depth of the slab to prevent spalling on the under side. Drills were then applied on the underside of the slab in the same manner. This precaution was not taken, however, with the holes inside the areas to be removed.

The spacing of the drill holes will vary from 4 in. for thick slabs to 15 in. for thin slabs with light reinforcing.

Depends on Varying Factors

By C. C. WESTFALL

Engineer of Bridges, Illinois Central, Chicago

Methods and costs of removing concrete vary with the character and location of the structure. This work can be divided into three classes: (1) Where the character and location of the structure are such that explosives can be used freely; (2) where the use of explosives is not practicable, but where concrete busters can be used; and (3) where the removal must be made to established lines without the use of explosives.

Without question, work coming under the first class can be done at the least cost. Work in the second class is somewhat more expensive, but the methods are usually simple. Extreme difficulties and high costs often characterize the third class.

During the recent years, the writer has completely removed three major structures. One, an abutment, which fell in the first class, was removed by means of jackhammers and explosives. The second, a pier, was removed by drilling and the application of the plug and feather method. The third, an abutment, was demolished with concrete busters. In each case the method was selected which was the most economical for the particular place and purpose.

In many instances the concrete buster is also best adapted for removing heavily reinforced sections. With this tool the concrete can be either stripped from the surface and the bars dislodged, or chipped through to expose them at designated points, after which they are cut with a chisel or torch.

Pneumatic equipment is available on most roads, and its use is so economical in the removal of concrete that the older hand methods can seldom be justified. In our own experience, the saving effected by a gang engaged in this class of work has often been sufficient to justify the purchase of a complete outfit for a single job.

The cost of removal depends on the method employed and the local conditions surrounding the work, so that there is a wide range of variation. As a matter of rough comparison, hand labor at the lower wages, formerly in effect usually cost around $20 a cu. yd. At the present rates, we are able to do such work for $5 to $10 a cu. yd. when pneumatic tools are employed.

Loading Rail

What are the best method and equipment for loading rail along main tracks? How many men should be assigned to handle the rail that is being loaded, and how should they be placed ?

Prefers a Light Rail Crane

By E. L BANION

Roadmaster, Atchison, Topeka & Santa Fe, Independence, Kan.

It is my opinion, based on long experience, that the best results are obtained with a light rail crane working from a flat car. The loading train should be made up of the desired number of empty flat cars, upon the second one of which the rail crane is mounted. The gang should consist of 1 foreman, 1 checker, 1 crane operator and 6 men, 3 of the latter on the ground and 3 on the cars. One man on the ground handles the rail tongs and the other two steady the rail. On the car, one man unhooks the tongs and the others guide and place the rail.

The train should be moved at a speed of two or three miles an hour. Every effort should be made to keep the train in continuous motion in order to avoid possible rough handling of the equipment. As a car is loaded, the crane is backed onto the third car and so on till all but the last car in the train are loaded. To accomplish this transfer, two 14-in. or 16-in. structural channels about 8 ft. long are used to bridge the gap between cars.

One machine with the organization as outlined will ordinarily pick up from six to eight cars of rail a day, depending on the interference from traffic. Normally it is desirable to load from one side of the track only. Otherwise the force will be increased without increasing the

productive results. If it is desirable to speed up the work, this can best be accomplished by placing an additional crane on the train and providing an independent gang to serve it. In this way both lines of rail can be cleaned up at the same time.

By adding a few extra men and the necessary cars, the old fastenings, scrap, etc., can be picked up, thus avoiding the necessity of a second work train at a later date.

Uses an Air Hoist

By J. MORGAN
Supervisor, Central of Georgia, Leeds, Ala.

On my territory, rail is loaded with an air hoist. This machine requires eight men and a hoist operator. Five men work on the ground and three on the car. One man is required on each side of the car to handle the tag line that is used to swing the boom. One man applies the tongs and the other two steady the rail as it is picked up and swung to the car. In the car one man unhooks the tongs and two men guide the rail and place it into position after it is released.

While a hoist of this type is inferior to modern power equipment, I have been able frequently to load rail at the rate of 60 an hour and do this without stopping the train. In my opinion, it is highly desirable to keep a rail-loading train in continuous motion, since frequent stopping creates a decided hazard, besides slowing down the work.

Work Train Costs More Than Men

By C. R. SCHOENFIELD
Roadmaster, Chicago, Burlington & Quincy, Aurora, Ill.

Several types of rail loaders are available for the purpose suggested in the question, but I consider the air loaders which operate by means of air from the train line to be very good. It is customary to mount two of these loaders on a flat car, which is placed between two empty cars when in operation. There is usually a large amount of small material that must also be picked up with the rail. For this reason, the proper make-up of the train is important.

To minimize switching, 3 empty rail cars should be placed behind the locomotive. These are followed in order by the rail loader, 3 more empties, 1 car for angle bars, 2 for tie plates and 1 for scrap.

It is fully as important to have the proper number of men assigned for the loading as it is to have the proper power equipment. The gang should be organized as follows: 3 men on the ground with each loader, 1 man to hook the tongs and 2 men to steady the rail; 3 men on each car that is being loaded, 1 man to release the tongs and 2 men to guide the rail to correct place and position; 2 men to operate the rail loaders; 1 man on each side of the angle-bar car; 1 man to count and pile angle bars; 3 men on each side to load tie plates, each of whom counts the number he loads; and 5 or 6 men loading scrap. This makes a gang of 29 men, which will load from 160 to 180 rails and the fastenings per hour of actual working time, sufficient to keep the train moving slowly, while every man is kept busy on his assignment.

We have been making a study of the most economical size of gang for loading rail and of the most advantageous method of assigning the members of the gang. I have tried to reduce the number of men below the figures given. I find, however, that when this is done, it becomes necessary frequently to stop the train, which not only slows up the entire loading operation, but often creates an unsafe condition.

If there is not a man at each end of the rail as it is lifted from the ground, it will start to swing and not infrequently gets out of control so that it must be dropped. If a man is taken off the car, one man is unable to land the rail and tier it alternately "base and ball." The tong man is too far from the end of the rail to be of any help. If he does help land the rail, he must go to the middle, release the tongs and return to the end to shift it into final position, an arrangement which definitely retards the loading. Work trains are necessary for many kinds of roadway work, but their cost is high. For this reason it is a serious mistake to work short handed on any operation that demands work train service.

Two Cranes Facilitate Loading

By L. J. DRUMELLER
Division Engineer, Chesapeake & Ohio, Hinton, W. Va.

An ideal method of loading rail along main tracks is to use light rail cranes and drop-end flat-bottom cars. The use of this equipment minimizes switching, since the crane is backed from car to car as the loading progresses. Two or more cranes can be employed, which not only results in faster loading, but also reduces the unit cost of the work train service.

If drop-end or flat cars are not available, two cranes can be employed with flat-bottom gondolas on either side of each crane. Where two cranes are used, one works on one side of the track and the other on the opposite side. If the center of the rail is marked in advance, it will facilitate the application of the rail tongs and make it possible to keep the train in continuous motion, which is desirable from a safety standpoint as well as to eliminate the lost time which mounts rapidly from frequent stops.

The number and assignment of the men depends largely on the type of equipment used for loading. If electromagnets are used, three men and an operator are sufficient, one man on the ground and two men in the car, with a dolly, one at each end to stow the rail properly. Rail tongs make four men necessary, two on the ground and two in the car. One man on the ground applies the tongs and the other steadies the rail. In the car one man releases the tongs and assists in properly stowing the rail, both being equipped with dolly bars.

Conserve Time of Work Train

By J. C. POWELL
Roadmaster's Clerk, Missouri-Kansas-Texas, Mokane, Mo.

A locomotive or rail crane of the full-revolving type is the best adapted for loading rail along main tracks, since it can be placed between two empty cars, thus reducing the time lost in switching out the loads. By arranging the crane and cars in this manner, a surprisingly large amount of the time of the loading gang is saved for productive effort, while a larger use factor is obtained from the work train itself, thus reducing the unit cost of this expensive but necessary aid to roadway work.

Usually the old fastenings and considerable scrap material must be loaded at the same time. The cars for this material should be placed behind the engine, while the cars for loading the rail should be in front so as to give the engineer a better view of the men engaged in loading the rail, which enables him to regulate the speed of the train to better advantage.

One crane operator, 1 foreman and 7 men constitute the most effective force for loading rail. One man equipped with a rail fork sets the rail up work-way in advance

to facilitate the application of the rail tongs; 1 man on the ground hooks the rail and 2 men steady it as it rises. There should always be 1 man on the car to unhook the tongs and 2 men to guide and stow the rail, seeing that it is properly laid to accommodate the next tier.

Where the fastenings, etc., are to be picked up, enough men should be added to keep this loaded as the train moves along, so that the entire job is completed as the train progresses. The number of men to be assigned to this operation will depend entirely on the amount of material to be loaded.

Equipment and Organization Important

By G. D. MAYOR

Assistant Cost Engineer, Chesapeake & Ohio, St. Albans, W. Va.

If the rail is to be loaded in the most economical manner, the equipment to be used and the proper organization of the gang are equally important. The equipment to be described has been used and found effective from the standpoints of speed, safety and economy, when employed with a properly organized gang. Equipment for loading rail should have the following characteristics:

1. The derrick or crane should be of the full-revolving type, so that it can be placed between two gondolas and thus minimize switching.
2. The boom should be of sufficient length to reach the centers of the adjacent cars without fouling the brake staff or brake wheels.
3. A steam derrick is preferred, because it is more flexible and operates more smoothly.
4. If available, considerable economy can be conserved by placing a second derrick in the work train some distance behind the rail crane. This machine should be equipped with an electro-magnet to pick up angle bars and scrap.

The use of this equipment calls for the simplest form of organization, which should consist of 1 foreman and 7 men, the latter being assigned as follows:

1 man setting up the rail and shifting it so that it does not foul with adjacent rails.
1 man hooking rail tongs.
1 man on ground, guiding rail as it is lifted.
1 man at end of car to guide rail into place.
1 rail-crane operator.
1 crane operator with second crane.
1 man on ground, guiding electro-magnet.

All rails should be marked for center and all scrap and small materials should be piled ahead of the loading train, to eliminate delay in the operation of the cranes. On multiple-track lines, where traffic has been diverted to facilitate rail laying, the loading train can follow immediately behind the rail gang to keep all material picked up currently. The maximum speed of the train should be about two miles an hour, in which event it is seldom necessary to stop. Only one line of rail is loaded at a time.

Light Crane Gives Best Results

By S. A. MEARS

Section Foreman, Missouri - Kansas - Texas, San Antonio, Tex.

My experience in loading rail is that a light crane that can be backed from car to car is the most efficient machine that can be used for this purpose. Such cranes are quick in action and no switchng is necessary to set out loads and place empties next to the crane.

One man is required to apply the tongs and two men should be employed to steady the rail as it leaves the ground. Two men in the car guide the rail into place and one man releases the tongs. The men at the ends should have light bars to shift the rail to final position after the tongs are released. The rail should be set up work-way and marked 1 ft. off center, the short end being in the direction the train is moving, to insure that this end will rise first and not catch on adjacent rails or nose into the ground. Using this method, one may safely move at a speed as high as three and frequently four miles an hour throughout the day.

An important factor in economical work is to keep the train moving continuously. It is a serious error to reduce the number of men below the point of economy.

Calking Lead Joints

What are the relative advantages and disadvantages of calking lead joints in cast iron pipe with an air hammer and doing this work by hand? What air pressure should be used with the pneumatic tool ?

There Is No Advantage on Small Pipes

By L. L. TALLYN

Division Engineer, Delaware, Lackawanna & Western, Scranton, Pa.

In my opinion there is no advantage in the use of an air hammer for calking lead joints in cast iron pipe for sizes below 12 in. in diameter. The use of such a tool is of decided advantage, however, on pipe of larger size, since a better job can be done at lower cost.

Air pressure for operating the pneumatic tools will vary with the size of the pipe and the lead joint, this range being from 65 lb. to 85 lb. An important factor in getting a good job, whether the calking is done by hand or with a pneumatic tool, is to select the proper sized tool for each joint that is to be calked and use it according to the variation in the joint. Especial care should be exercised to insure that, after calking, the joint has a clean edge inside as well as outside of the lead joint. Substitutes for lead are now available which do not require calking and it will often prove economical to use such materials.

Use of Air Hammers Is Limited

By Engineer of Water Service

In my opinion the field for air hammers for calking lead joints in cast iron pipe is limited to the construction of long lines of large diameter pipe. I have been unable to find any economy in their use for ordinary maintenance or for constructing long lines of the smaller sizes of pipe. Calking with pneumatic tools necessitates moving the tool from joint to joint and the frequent moving of the compressor unit. If the topography is favorable, this is not a major objection, so that there may be an advantage in the use of pneumatic equipment, provided the size of the pipe and length of the line are such as to justify its use.

For pipe of 12-in. or under, I question whether there is any economy in the use of air-operated tools. It is true that the actual time of calking is less, but when the cost of compressing the air and moving the equipment is included my experience indicates that there is no economy. The use of air tools on even the larger sizes of pipe has been limited. This practice does not meet with the approval of the trades involved, so that it has seldom been adopted in municipal work. Furthermore, there is a growing tendency to use substitutes for lead in joints, which do not require calking.

It is entirely possible that with the continued use of lead and the construction of larger lines, the use of the air hammer will become more extensive. The air pressure is of minor importance, since the mechanic handling the tool must use his judgment as to the tightness of the calking regardless of the pressure. The manufacturer usually specifies 80 lb. as the most efficient pressure.

Prefers Substitute Jointing Materials

By R. L. HOLMES

Engineer Water Supply, Texas & Pacific, Dallas, Tex.

It appears to me that better results can be obtained by calking lead joints by hand. By using experienced workmen and medium air pressures, however, the work can probably be done faster with air tools, and with care the jointing can be done fully as well. It should be borne in mind that as a joint filler, lead is quite expensive when compared to other jointing materials.

We recently completed a pipe line 37.5 miles long, comprising 8-in., 10-in. and 12-in. cast iron pipe. It may be of interest that this line was laid throughout with cement joints and that the operating pressure for the calking tools ran as high as 180 lb. per sq. in. When the line was tested, none of the joints blew out and only 32 showed any signs of leaking. These were reworked and today the line is in full operation without any leaks. The contractors had no previous experience in cement jointing, but inspectors were placed on the job who were thoroughly familiar with this class of work, and it was only a short time before the workmen were as efficient as could be desired.

Special care was used in placing the jute, the number of rings being the same as in a lead joint. Immediately after it was driven tight, the neat cement was applied and calked in the same manner as lead. Each jointing gang consisted of 1 man to distribute the jute and mix the cement, 2 men to apply and pack the jute and 3 men placing and calking the cement. Each gang completed 15 joints an hour, requiring 1 bag of cement to every 9 joints. The total cost of labor and material was less than the lead only would have cost, thus saving approximately $20,000 on the project.

Renewing Ties

When renewing ties without giving the track a general raise, what methods should be employed to minimize the disturbance to line and surface ?

Track Jacks Should Not Be Used

By R. H. GILKEY

Division Engineer, Central of Georgia, Savannah, Ga.

Track jacks should never be used when making tie renewals, if this work is to be done without giving the track a general raise. To do this the crib adjacent to the tie to be removed should be cleaned out slightly below the old bed. The tie should then be shifted over to this space and pulled out in the usual manner. The next step is to prepare the bed for the new tie and insert it. It should then be tamped solidly to an even bearing, care being exercised not to spring the rail. If the renewal is being made in unballasted track, the jack can usually be used without disturbing the line and surface, thus making it unnecessary to remove the crib.

Lifts Rail After Pulling Spikes

By J. MORGAN

Supervisor, Central of Georgia, Leeds, Ala.

While there are several methods that have been employed to renew ties without disturbing the line and surface, it is my experience that the most economical practice is to pull all spikes from the ties that are to be removed, and then raise the remaining spikes slightly for some distance each way. If this is done, the rail can be lifted enough to facilitate the removal of the old tie and the insertion of the new one. This method makes it unnecessary to crib the track where the ties are to be removed, thus saving considerable time. One man working part time can lift the necessary spikes ahead of the work while a second man can redrive the spikes in the sound ties in less time, after the renewals are completed.

Important to Clear Out Crib

By ROY HAHN

Clerk to Master Carpenter, Seaboard Air Line, Tampa, Fla.

When spotting ties without raising the track, the rail should not be lifted and this precludes the use of a track jack, since this is likely to disturb both line and surface. It has always been my custom to remove the crib adjacent to the tie that is to come out, cutting only deep enough to insure space for the tie to slip under the rail after it has been shifted over to the crib. This method avoids any disturbance to the line and surface.

After removal, the bed is prepared to receive the new tie which should be tamped thoroughly. Next the tie plate is inserted. This will lift the rail above true surface by the thickness of the plate, but this will be taken care of by the settlement that occurs with the passage of one or two trains.

Depends on Character of Ballast

By S. A. MEARS

Section Foreman, Missouri - Kansas - Texas, San Antonio, Tex.

If the renewal is to be made in rock or any other class of ballast that is inclined to "roll," the crib adjacent to the tie should be excavated to sufficient depth to permit dragging out the old tie after it is shifted to the trench thus formed. If the ballast is of such a character that settlement is not likely to occur, the tie plate should be applied before tamping, otherwise it should not be applied until several trains have passed.

If the renewal is made in unballasted track or in ballast that does not roll, considerable time can be saved by using jacks under each rail to lift the track enough to facilitate removal and insertion. Care should be used to drop both jacks simultaneously to avoid disturbance to the line.

Do Not Dig Below the Old Bed

By ROBERT WHITE

Section Foreman, Grand Trunk Western, Drayton Plains, Mich.

It is a serious mistake, which is often made by even experienced trackmen, to dig far below the bottom of the tie that is to be removed. This practice destroys the lateral support to the old bed and it takes longer for the new tie to reach a final bearing. When tie plates are in service, they should not be replaced on the new tie until one or more trains have passed, if the ballast is gravel, chatts or cinders. If it is stone, the plates should be applied before the tie is tamped.

When making tie renewals as indicated by the question, it is good practice to go back over the track the first thing the following day to care for weak places that may have developed. At the time the renewals are made, the track should be put to correct gage, even if this requires considerable time.

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Building Insulation

What advantages, if any, are there in the use of building paper or insulating board in the exterior walls of railway buildings? What are the relative advantages and disadvantages of the two materials ?

They Reduce Heat Losses

By J. SCHOFIELD

Architect, Canadian National, Montreal, Que.

In modern construction, the use of building paper and insulating board in the exterior walls of railway buildings that are to be occupied is a practical necessity in severe climates such as that of Canada and the Northern sections of the United States. The use of these materials is generally restricted to frame buildings or other buildings having thin walls in which the heat losses are excessive unless insulation is provided. The purpose of their use is wholly to reduce heat losses through the walls, roofs and floors of the buildings.

From an economical standpoint, a good insulating board is an excellent and constant dividend payer. In fact, the dividends are so high that the capital investment is soon refunded through: (1) the saving effected in fuel; (2) the greater efficiency with which employees work under conditions of reasonable comfort; and (3) in summer this form of protective covering continues to aid efficiency. These advantages are becoming more generally recognized, with the result that buildings of the types mentioned are seldom constructed without consideration of provisions for adequate insulation.

They Are not Comparable

By Designing Engineer

It is fundamental that comfortable temperatures must be maintained in railway buildings, whether they are for public use or are to be occupied by employees. Through the use of properly selected insulating materials, the amount of fuel required to maintain such temperatures can be measurably reduced.

According to recent tests by the Bureau of Standards, the addition of ½ in. of standard fibrous or cellular insulation to the walls, roof and floors of a building will reduce the amount of fuel required to maintain comfortable temperatures by about 20 to 30 per cent. This saving can be realized, however, only if the insulation is added to the regular construction. It is an important fact that the substitution of insulating board for some other structural member, such as the sheathing, affords little if any insulating value.

While the addition of insulating material to the regular building construction increases the cost of the building and, consequently, the annual interest charges, this is largely offset by the fact that so large a heating plant will not be required. The reduction in the cost of the heating system generally balances the cost of the insulation, so that the amount saved in fuel is clear gain.

There is also a decided advantage in the increased comfort during hot weather, since the insulation excludes considerable exterior heat.

A comparison between insulating board and building paper is scarcely possible. While they serve the same purpose, they do it in distinctly different ways. Neither is a substitute for the other; both should always be used. The function of building paper is to prevent leakage of air from or into the building through the cracks which inevitably develop in practically all types of buildings. Warm air leaks out under all conditions, while there is a decided infiltration of cold air as a result of wind pressures. Insulating materials, on the other hand, as their name indicates, decrease the heat losses that occur through conductance.

The use of building paper is an essential of all good building construction. It is particularly important in railway buildings, because exposed locations usually subject such buildings to cold winds to a greater extent than the average building.

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Poor Spiking

What effect, if any, does poor spiking or the use of worn spikes have on track conditions? What precautions should be observed in spiking to obtain best results ?

Poor Spiking Indicates Lax Supervision

By ROY HAHN

Clerk to Master Carpenter, Seaboard Air Line, Tampa, Fla.

From long experience in track maintenance, it is my observation that nothing is more essential than good spiking in maintaining first class track. Workmanship or material that is below standard will result in poor line and improper gage. This in turn leads to irregularities in cross level and bad riding track. Poor spiking always results from lax supervision and is often traceable directly to the practice either of allowing inexperienced men to spike or the use of worn spikes. To obtain the best results, good straight spikes should always be used, setting them perpendicular and driving them snug against the rail without bending.

Results in Numerous Evils

By H. BECKER

Section Foreman, St. Louis - San Francisco, Rush Towers, Mo.

The most direct effect of poor spiking and the use of worn spikes is incorrect gage. Indirectly both the line and level are affected, while the service life of the ties may be materially shortened by both practices. Track cannot be made to ride smoothly if the gage is irregular. Neither can it be kept in line and surface. Worn spikes permit a measurable amount of lateral play to the rail which allows considerable room for kinking, if the rail creeps and becomes tight. This, added to such vertical play as may be present, increases the amount of mechanical wear on the ties, which, combined with careless spiking may cause early failure of the ties involved.

Only the simplest precautions are necessary to overcome the ill effects of the practices mentioned. The first is to use only new or unworn second-hand spikes, provided the latter are straight. It is my practice to set them snug against the rail but with a slight inclination

toward it, since this gives a better bearing when the spike is driven home. The driving should be done in such a manner that the spike keeps its contact with the base of the rail and under no circumstances should the spiker be permitted to bend it to make a snug fit.

Poor Spiking Causes Poor Line

By R. H. GILKEY
Division Engineer, Central of Georgia, Savannah, Ga.

Poor spiking almost invariably causes poor line and gage. In driving, spikes should always be started vertically and driven straight, since both their holding power and their resistance to lateral pressure are greater when driven in this manner. Under no circumstances should spikers be allowed to set the spikes on a slant and then bend them toward or over the flanges as they approach full penetration.

Spikes that are throat cut or otherwise worn can be driven, if necessary to do so, on the outside of the rail, where shoulder tie plates are in service, but this is not good practice.

Worn Spikes Should not be Used

By L. G. BYRD
Bridge and Building Supervisor, Missouri Pacific, Wynne, Ark.

I consider correct gage to be one of the most important items in the maintenance of good track. For this reason, worn spikes should never be used in main-line track or elsewhere where it is necessary to maintain correct gage. To obtain best results, ties should be sized and bored before they are treated. When they are installed, the spikes should be set firmly against the flange of the rail and driven vertically. As a rule, worn spikes cannot be given a firm bearing against the rail.

When spiking, the rails should always be thrown to gage with bars and held in position until the gage spiking is completed. Spikers should not be allowed to crowd the rail to gage by bending the spike just before it is seated. Among the reasons why this should be prohibited is that the spike is weakened by being bent and in a short time allows the rail to spread.

Experienced Men Should Do Spiking

By W. J. HOUSE
Bridge and Building Foreman, New Orleans & North Eastern, Poplarville, Miss.

Poor spiking and the use of worn spikes result in failure to maintain good line and gage. Worn spikes, if in sufficient numbers, permit tight rail to kink in the spikes, giving a distorted line, while rail shows a greater tendency to creep where they are used. Rail that is kinked in this manner often takes a permanent set so that it is impossible to either line or gage it satisfactorily.

My experience is that the best results are obtained when the ties are exactly at right angles to the rail, the tie plates are placed with the shoulder snug against the rail flange, and just enough spikes driven to make the track safe. One or more trains should pass over the track before spiking is completed, to firmly bed the tie plates. Some readjustment is invariably necessary owing to the fact that the tie plates seldom settle vertically. New spikes, or those that are unworn and otherwise in good condition, should always be used.

Gaging is of the greatest importance. In doing this work both spikes should be driven simultaneously at each setting of the gage to secure accurate results. Spiking should never be done by inexperienced men.

Less Rail Produced in 1930

ACCORDING to figures issued by the American Iron & Steel Institute, New York, the production of steel rails in the United States totaled 1,873,233 gross tons in 1930, a decrease of 848,905 gross tons or 31.2 per cent under the output in 1929 and the smallest production for any year since 1897. The production of rails weighing 100 lb. and less than 120 lb. per yd. totaled 835,496 gross tons, a decrease of 398,103 tons, or 32.2 per cent, from the output of these weights in 1929. Rails weighing 120 lb. per yd. and over were produced in the amount of 592,933 tons last year, which is the smallest total for this classification since 1927, the first year that rails of this weight were grouped separately in the statistics. This figure was a reduction of 241,672 tons, or 28.7 per cent, under 1929, and marked the first year since 1927 that this classification failed to show an increase. The production of rails weighing 100 lb. per yd. and over totaled 1,428,429 gross tons last year, a reduction of 639,775 tons, or 30.9 per cent, under 1929 and was the smallest production of this classification since 1924.

The production of alloy steel rails last year totaled 4,687 gross tons, an increase of 2,722 tons over 1929, and the third highest figure for this classification since 1921, the first year for which records are shown.

Production of Rails by Weight Per Yard, 1917-1930

Years	Under 50 pounds	50 and less than 85	85 and less than 100	100 and less than 120	120 pounds and over	Total gross tons
1917	308,258	882,673	989,704	763,526		2,944,161
1918	395,124	665,165	888,141	592,462		2,540,892
1919	263,803	495,577	965,571	478,892		2,203,843
1920	489,043	433,333	952,622	729,118		2,604,116
1921	211,568	214,936	902,748	849,566		2,178,818
1922	265,541	274,731	728,604	902,900		2,171,776
1923	272,794	300,907	864,965	1,465,850		2,904,516
1924	191,046	213,274	853,431	1,175,581		2,433,332
1925	163,607	219,648	765,371	1,636,631		2,785,257
1926	197,260	256,287	797,662	1,966,440		3,217,649
1927	161,836	173,257	539,445	1,314,424	617,524	2,806,486
1928	134,197	125,726	465,393	1,203,749	718,428	2,647,493
1929	141,362	102,944	409,628	1,233,599	834,605	2,722,138
1930	95,626	81,299	267,879	835,496	592,933	1,873,233

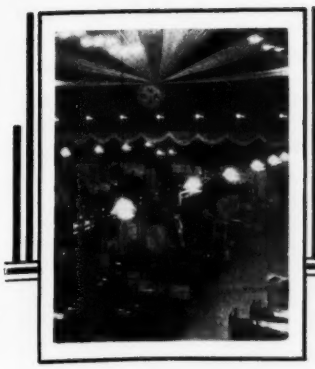
Production of Rails by Processes, Gross Tons, 1915-1930

Years	Open-hearth	Bessemer	Electric	Rerolled*	Total
1915	1,775,168	326,952	.....	102,083	2,204,203
1916	2,269,600	440,092	.....	144,826	2,854,518
1917	2,292,197	533,325	.....	118,639	2,944,161
1918	1,945,443	494,193	.....	101,256	2,540,892
1919	1,893,250	214,121	50	96,422	2,203,843
1920	2,334,222	142,899	297	126,698	2,604,116
1921	2,027,215	55,559	5	96,039	2,178,818
1922	2,033,000	22,317	.....	116,459	2,171,776
1923	2,738,779	25,877	118	139,742	2,904,516
1924	2,307,533	16,069	.....	109,730	2,433,332
1925	2,691,823	9,687	.....	83,747	2,785,257
1926	3,107,992	12,533	.....	97,124	3,217,649
1927	2,717,865	1,566	.....	87,055	2,806,486
1928	2,580,141	2,718	438	64,196	2,647,493
1929	2,626,163	3,486	723	55,766	2,722,138
1930	1,834,933	2,137	45	36,118	1,873,233

*Rerolled from old steel rails.

Production of Alloy-Treated Steel Rails, 1921-1930

Years	Total production. Gross tons	Production by alloys: Titanium	Production by alloys: Other alloys	Production by processes: Open-hearth and elect	Production by processes: Bessemer	Production by weight per yard: Under 50 lbs.	Production by weight per yard: 50 and under 85 lbs.	Production by weight per yard: 85 and under 100 lbs.	Production by weight per yard: 100 and under 120 lbs.	Production by weight per yard: 120 lbs. and over
1921	6,276	2,804	3,472	6,276	.....	.....	71	4,277	1,928	
1922	3,163	2,493	670	3,163	.....	.....	321	835	2,007	
1923	2,142	346	1,796	2,142	.....	.....	56	317	1,769	
1924	5,167	1,696	3,471	5,167	.....	.....	...	847	4,320	
1925	4,009	1,616	2,393	4,009	.....	70	47	.....	3,892	
1926	4,216	1,099	3,117	4,216	.....	.....	42	1,027	3,147	
1927	1,265	.....	1,265	1,265	.....	.....	...	374	391	500
1928	6,453	3,711	2,742	6,453	.....	29	...	879	1,652	3,893
1929	1,965	486	1,479	1,965	.....	100	...	748	967	150
1930	4,687	517	4,170	4,687	.....	146	...	885	1,137	2,519

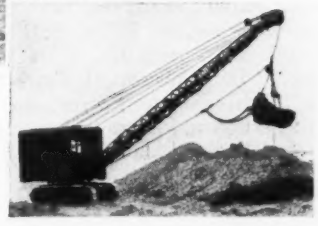


NEW AND IMPROVED DEVICES

A New Convertible Excavator

THE Harnischfeger Corporation, Milwaukee, has developed a ⅜-cu. yd. capacity convertible excavator of which the design and construction is similar in most respects to the large P & H excavators. The new unit, which is known as Model 200-A, is built largely of alloy steels. It is designed to meet the demands of a convertible excavator, weighing less than 14 tons.

The crawler treads are equipped with the P & H double sprocket drive on link pins instead of the links themselves. All machinery on the revolving frame is placed in a compact yet accessible manner. The drums are mounted on separate shafts with the jack shaft between them, and the entire gear train, running in oil, is located on the right side of the machine. All shafts that operate in excess of 40 r.p.m. are roller bushed and the clutches are of the internal expanding type. The hoist and crowd clutches are interchangeable as are also the five main outside-type brake bands. The boom hoist is of the planetary type with an automatic safety load brake.

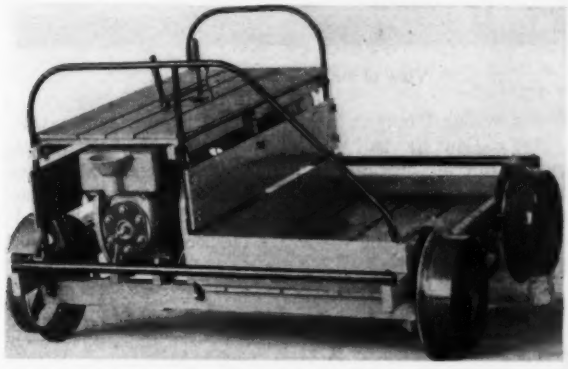


(Left) The 200-A as a Shovel and (Below) as a Dragline

The chain crowd with which this excavator is equipped is an improved form of the regular P & H crowd. It is said that the dipper can be returned at more than twice the speed at which it is crowded out, and that the raising and lowering of the boom does not disturb the adjustment of the crowd chains. The boom of the excavator is 17 ft. long and the dipper sticks are 12 ft. in length, giving a total dumping height below the door of 17 ft. The dragline and crane booms are of lattice box-section design with a standard length of 30 ft. The machine is convertible for shovel, dragline, clamshell-crane, trenchoe, or skimmer-scoop operation. It may be equipped with either a four or a six-cylinder 45-hp. gasoline engine.

A New Side-Load Motor Car

A MOTOR car in which the engine and all working parts are situated under the seat at one side of the car, while the remainder of the space is occupied by a tool tray, has recently been developed by Fairmont Railway Motors, Fairmont, Minn., and is known as the 59. This arrangement is said to double the size and utility of the space around water cans and other objects, as compared with cars that have the seat in the middle. The tray area of the car is 45 in. long and 27 in. wide, while the seat is 44 in. long and 23½ in. wide, with space for seating two men comfortably and for accommodating four men. The seat does not overhang the wheels and for this reason the car retains the safety of the center-load car.



The New Fairmont 59 Motor Car

Power is provided by a Type OB engine which develops 8 hp. at car speed and is ample to handle the full load of the car with a windshield under all conditions. Power transmission is by an endless cord belt and includes a Timken bearing belt control pulley, an aluminum axle pulley and a Hyatt steady box. Engine vibration has been minimized by the use of a Diesel-type aluminum alloy piston and connecting rod.

The 14-in. wheels of the car are torpedo proof, being

made of manganese-carbon alloy steel. It is said that these wheels save 65 lb. in the weight of the car and that they are extremely durable. All four wheels are equipped with oak brake shoes operated by a lever.

Gas-Electric Powered Wrecking Crane

THE Cleveland Union Terminals Company has recently placed in service a double-end wrecking crane which is said to be the first wrecking crane to be powered by gasoline-electric power units, being designed particularly for service under buildings in electrified zones where clearances are close. This machine, which has a capacity of 105 tons at each end, was built by the Industrial Brownhoist Corporation at its Bay City, Mich., plant.

This crane is equipped with three independent power units, any one of which, or a combination of all three, will operate it. It is entirely independent of outside sources of current supply and no third-rail or pantagraph contacts are provided. These units consist of two 225-hp. Winton gasoline engines operating at 1050 r.p.m., direct-connected to 350 amp. 400-volt direct current generators and one 208-cell Exide TLA-17 storage battery having a capacity of approximately 400 amp. per hr. at a 4 hr. discharge rate at 400 volts. All of the movements of the crane are controlled electrically.

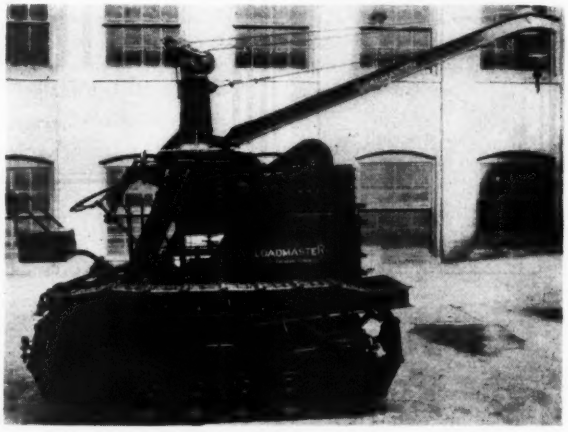
The capacity of each end of the crane is 105 tons with the boom straight ahead or swung six feet ahead of the coupler. The capacity at 90 deg. to the track is 105 tons at 13 ft. 8 in. radius. The capacities, over the side of the car without outriggers, are relatively low. The outriggers extend the full width of the car, one at each corner and one at the center on each side. These extend to a blocking position 8 ft. 6 in. from the center of the track. The two center outriggers and the two at the end where the lift is being made are blocked when the crane is in use.

A View of the New Wrecking Crane

A Crawler Crane for Close Work

THE Bucyrus-Erie Company, South Milwaukee, Wis., has begun the construction of a crane especially adapted for work that involves both hauling and hoisting under conditions subject to considerable variation. The new machine is called the "Loadmaster" and consists of a revolving crane mounted on a McCormick-Deering gasoline tractor of the heavy-duty type. The tractor is equipped with rubber-tired wheels, or with Trackson crawlers. A standard boom is 10 ft. long and is mounted above the engine where it is raised or lowered or swung in a complete circle by power from the gas engine. A standard 10-ft. boom has a rated capacity of 3,500 lb., while its working reach can be extended to 14 or 16 ft. by using a longer boom. With an overall width of only 65 in., and an overall length, exclusive of boom, of 120 in., the crane can be manipulated with ease, while the overall height of 8 ft. 10 in. makes it possible to operate the crane through doorways.

With the boom mounted above the engine and designed to swing in a complete circle, it is possible to do crane work without interfering with the hauling movements and to operate in close quarters without having to maneuver the crane or tractor to lift and deposit loads. The utility of the machine has been further enlarged by adapting it to carry a 160-cu. ft. displacement air compressor as an integral part of the machine wherever air compressor work is involved. With the crawler tractor and the air compressor, it is possible to keep abreast of an air-consuming job without regard to the unevenness of the ground and without the inconvenience of handling unwieldy lengths of hose.



A View of the Loadmaster

New Books

Roadmaster's Proceedings

PROCEEDINGS, Roadmasters' and Maintenance of Way Association of America. 214 pages, illustrated, 6½ in. by 10 in. Bound in cloth. Published by the Association, T. F. Donahoe, secretary, 428 Mansion Street, Pittsburgh, Pa.

As in past years, this issue of the Proceedings contains a complete report of the forty-eighth annual convention of the association, which was held at the Hotel Stevens, Chicago, on September 16-18, 1930. It contains committee reports on Getting the Most From Labor-Saving Equipment; the Equation of Track Mileage as a Basis for the Distribution of Forces; the Division of Work Between Section and Extra Gangs; Recent Developments in Roadbed Drainage; and the Use of Motor Trucks in Track Work.

The Proceedings also contains papers on Track Maintenance As Affected by Signal Operation, by R. A. Sheets, signal engineer of the Chicago & North Western; on Looking Ahead in Maintenance of Way Work, by Lem Adams, general supervisor maintenance of way of the Union Pacific System; on Laying Rail on the Pennsylvania, by R. W. E. Bowler, engineer maintenance of way on the Pennsylvania; on Safety in Maintenance of Way Work, by J. E. Long, superintendent of safety of the Delaware & Hudson; and on European Track Maintenance and Construction, by J. V. Neubert, chief engineer maintenance of way of the New York Central. There are also included addresses by S. H. Cady, general solicitor of the Chicago & North Western, and L. C. Fritch, vice-president, Chicago, Rock Island & Pacific.

NEWS OF THE MONTH

Ringer to Head Joint Committee on Crossing Protection

F. Ringer, chief engineer of the Missouri-Kansas-Texas, has been appointed chairman of the Joint Committee on Highway Grade Crossing Protection of the American Railway Association, succeeding the late W. J. Towne.

Motor Coach Regulation in New York

A recent bill passed by the New York Legislature places common carrier motor coach companies under the jurisdiction of the Public Service Commission of that state. This law requires motor coach companies to obtain certificates of convenience and necessity, and gives the commission authority to enforce just and reasonable rates and safe and adequate service.

Ferry Service Across Lake Michigan Planned by Penna.

The establishment of freight car ferry service across Lake Michigan between Milwaukee, Wis., and Muskegon, Mich., as a means of creating a shorter rail line to the east, is being contemplated by the Pennsylvania. The plan of this company is to build a ferry dock at Muskegon and to arrange for the use of municipal facilities at Milwaukee under lease.

February Freight Traffic Down 21.2 Per Cent

Freight traffic moved by the Class I railroads in February amounted to 27,079,240,000 net ton-miles, a reduction of 21.2 per cent as compared with February, 1930, and of 29 per cent under the same month of 1929, according to reports compiled by the Bureau of Railway Economics. For the first two months of the year the total was 57,387,606,000 net ton-miles, a reduction of 19.2 per cent under that of the first two months of 1930, and of 25.8 per cent under that for the same period of 1929.

Discharged Trackman Gets Life for Wrecking Train

George Darnell, a discharged trackman, has been sentenced to life imprisonment for causing the derailment of a passenger train of the St. Louis-San Francisco at Henryetta, Okla., on August 18, 1929, which resulted in the death of 13 passengers. Darnell was arrested on April 5, at Parsons, Kan., by railroad and city police and was taken to Henryetta where he confessed and pleaded guilty to a murder charge. He became angered at being discharged and tampered with a switch at a time when he expected a freight train to pass, believing that the train would be derailed.

Fewer Freight Cars and Locomotives

In the first two months of this year the Class I railroads placed 2,631 new freight cars in service, as compared with 18,217 in the same period last year, according to the American Railway Association. New locomotives placed in service in the first two months totaled 26 as against 113 last year. On March 1, there were 8,669 new freight cars on order, as compared with 31,239 on the same date last year, while the locomotives on order numbered 86, in contrast with 450 last year.

Wage and Labor Statistics for 1930

The average number of railway employees in the service of Class I railroads for the year 1930 was 1,510,688, as compared with 1,686,769 in 1929 and 1,680,187 in 1928, according to the Interstate Commerce Commission. As compared with 1929, the decrease was 10.44 per cent. The total compensation of railway employees last year was $2,590,274,843, a decrease of 11.92 per cent as compared with 1929. The average straight-time hourly earnings for all employees working on the hourly basis increased from 62.5 to 63.5 cents, and the average straight-time daily earnings of all employees working on the daily basis increased from $8.42 to $8.55.

Railroad Casualties Are Fewer

In 1930, only seven passengers were killed in train accidents in the United States as compared with 36 in 1929, and an annual average of 77 for the five years preceding 1927, according to the preliminary annual statement of the Interstate Commerce Commission. The total number of persons killed on the railroads last year from all causes and in all classes numbered 5,481 as compared with 6,496 in 1929, a decrease of 15.63 per cent; while those injured numbered 49,430 as compared with 76,995 in the previous year, a reduction of 35.8 per cent. The total number of employees killed per million man-hours was 0.26 as against 0.32 in 1929. Those injured per million-man hours numbered 9.70 as compared with 14.22 in 1929.

Estimate Decrease of 5.8 per cent in Second Quarter Loadings

The shippers' regional advisory boards of the country estimate that carload shipments of the 29 principal commodities in the second quarter of 1931 will approximate 7,029,231 cars, a reduction of 430,805 cars, or 5.8 per cent, below the loadings for the corresponding period of 1930. Eleven of the 13 advisory boards anticipate reductions, while in the Pacific Coast and the Ohio Valley regions it is estimated that the carloadings will increase 4.9 per cent and 2.4 per cent, respectively. The anticipated decreases range from 0.4 per cent in the Central Western region to 11.3 per cent in the Northwest region. It is estimated that increases will occur in the loadings of citrus fruits; fresh vegetables, except potatoes; petroleum and petroleum products; and chemicals and explosives.

Crossing Fatalities Decrease

According to reports filed by the railroads with the Interstate Commerce Commission, the number of fatalities resulting from accidents at highway grade crossings in 1930 totaled 2,020, a reduction of 465, or nearly 19 per cent as compared with 1929, and the lowest for any year since 1922. This reduction took place in the face of an increase of about four per cent in all fatalities on the highways. Persons injured in grade crossing accidents last year totaled 5,517.

Two Additional Roads Establish Store-Door Service

Following the announcement last month that 11 southwestern roads planned to establish store-door pickup and delivery service, two additional roads, the Union Pacific and Chicago, St. Paul, Minneapolis & Omaha, have signified their intention of establishing this form of service. The former road will offer the service through its motor coach operating subsidiary, Union Pacific Stages, Inc., and will handle merchandise

freight on its own bills of lading, charging the same rates as for station-to-station service. The Omaha road will charge from 5 cents to 25 cents per 100 lb. for picking up shipments, while delivery will be made at local cartage rates. This road plans to establish the service at a number of selected points at present and to extend it to all points on the system if it should prove successful.

Freight Claims Decrease

Claims paid in 1930 by the Class I railroads for the loss and damage of freight totaled $34,974,056, a reduction of $1,139,847, or 3.2 per cent, under 1929, and the smallest sum reported for any year since 1916, according to the Freight Claim Division of the American Railway Association. However, on the basis of the total number of cars handled, this figure averaged 78 cents per car, as against 68 cents in 1929. While there has been a decided decline in the amount of loss and damage claims paid on most commodities during the last few years, there has been a continued increase in the claims paid on fresh fruits, melons and vegetables.

High-Speed Trains With Many Stops Aid Passenger Business

That the railroads may win back much of the short distance passenger traffic that has been lost to the highways by the operation of well-equipped high-speed trains making frequent stops, is believed by H. E. Newcomet, vice-president of the Pennsylvania. Such a train, known as the Mercantile Express, was established by the Pennsylvania between Pittsburgh, Pa., and Chicago last July and has been placed on a very profitable basis. The train makes this run of 468 miles in 10 hr. 15 min., and makes 12 regular stops at an average distance of 27 miles apart, with four conditional stops. The scheduled running time between stations averages about 60 miles an hour. This train also carries through New York-Chicago cars on a schedule of 20 hr. 20 min. Eastbound service of similar character is also provided.

A.C.L. Has Lowest Safety Record

Casualties to employees of only 1.66 per million man-hours worked was the record established by the Atlantic Coast Line last year. This figure is lower than that of any other Class I road reporting, and is the lowest rate ever attained by a Class I road working more than 50 million man-hours yearly. It compares with the casualty rate of the A. C. L. of 26.95 per million man-hours in 1923 and of 7.38 in 1929. In 1930 the company decided to compete for the trophy offered by the National Safety Council to Class I roads in Group B, or those working between 50 and 100 million man-hours yearly. An extensive safety program was instituted, including a system of divisional safety awards, the organization of safety committees, the thorough investigation of accidents, the distribution of posters, bulletins and other printed matter, and the extensive use of the Atlantic Coast Line News, an employee publication, for the furtherance of the program. The transportation department of the Third (Grand) division, had a record of 1.61 casualties per million man-hours.

Rock Island and Milwaukee Complete Joint Line

The new joint double-track line of the Chicago, Milwaukee, St. Paul & Pacific and the Chicago, Rock Island & Pacific between Polo, Mo., and Birmingham, 58 miles, has been completed and it is expected that the operation of freight trains over the line will be commenced about July 1, while passenger train operation will begin about October 1. Including the construction by the Rock Island of a 37-mile single track line between Polo and a connection with its line at Coburn, Mo., the total cost of the project is about $12,000,000.

Trucks and Trailers Increase

The increase in the registration of motor trucks and road tractors in 1930 as compared with 1929 was sufficient to overcome a slight decrease in the registration of passenger motor vehicles, resulting in a net increase of 0.08 per cent in total motor vehicle registrations, according to reports compiled by the Bureau of Public Roads, U. S. Department of Agriculture. The registration of automobiles, taxis, and buses last year numbered 23,042,840, a decrease of 78,749 vehicles as compared with this figure for 1929, while the registration of motor trucks and road tractors was 3,480,939, an increase of 101,085 vehicles, thus giving a net increase of 22,336 in the total number of registrations. In addition to these figures, 41 states reported a registration of 262,507 trailers, a gain of 69,463, or more than 36 per cent, as compared with the figures for 1929. This increase of trailers over the previous year was the largest recorded for any year since the bureau began the compilation of these records in 1921.

Arbitrators Chosen for Four-System Consolidation Plan

Controversial points, which must be ironed out before the recently announced plan for consolidating the eastern roads into four systems can be submitted to the Interstate Commerce Commission for consideration, have been placed before a group of three arbitrators for settlement. Points to be settled by the arbitrators include the question of whether the Pennsylvania shall have trackage rights over the Nickel Plate between Ashtabula, Ohio, and Brocton, N. Y.; the disposition of the Virginian; the price to be paid by the Van Sweringen interests for stock of the Lehigh Valley held by the Pennsylvania; and the question of trackage rights for the Pennsylvania over the Lehigh Valley into Allentown, Pa., and Bethlehem. The first point is to be settled by George T. Slade, a director of several railroads, while the remainder of the questions will be decided by Thomas W. Lamont of J. P. Morgan & Co., and Thomas Gates, president of the University of Pennsylvania.

Railway Employment Decreases Further

Employees in the service of Class I railroads as of the middle of February numbered 1,316,435, a further reduction of about 27,000 as compared with the number in January, and a decrease of 14.75 per cent as compared with the number in February, 1930, according to the preliminary statement of railway employment of the Interstate Commerce Commission. As compared with February, 1929, the reduction was 18.04 per cent. The number in the maintenance of way and structures group showed the greatest reduction, which was 19.05 per cent as compared with last year and 21.4 per cent as compared with 1929.

Pennsylvania Adopts New 152-lb. Rail Section

The Pennsylvania has adopted a new 152-lb. rail section of special design for use in its heaviest traveled main-line tracks, and a new 131-lb. rail section of special design for use generally in other main-line tracks. These new sections supersede the present 130-lb. P. S. rail, which was adopted in 1916. The first heats of the heavy section will be rolled by the United States Steel Corporation and the Bethlehem Steel Company.

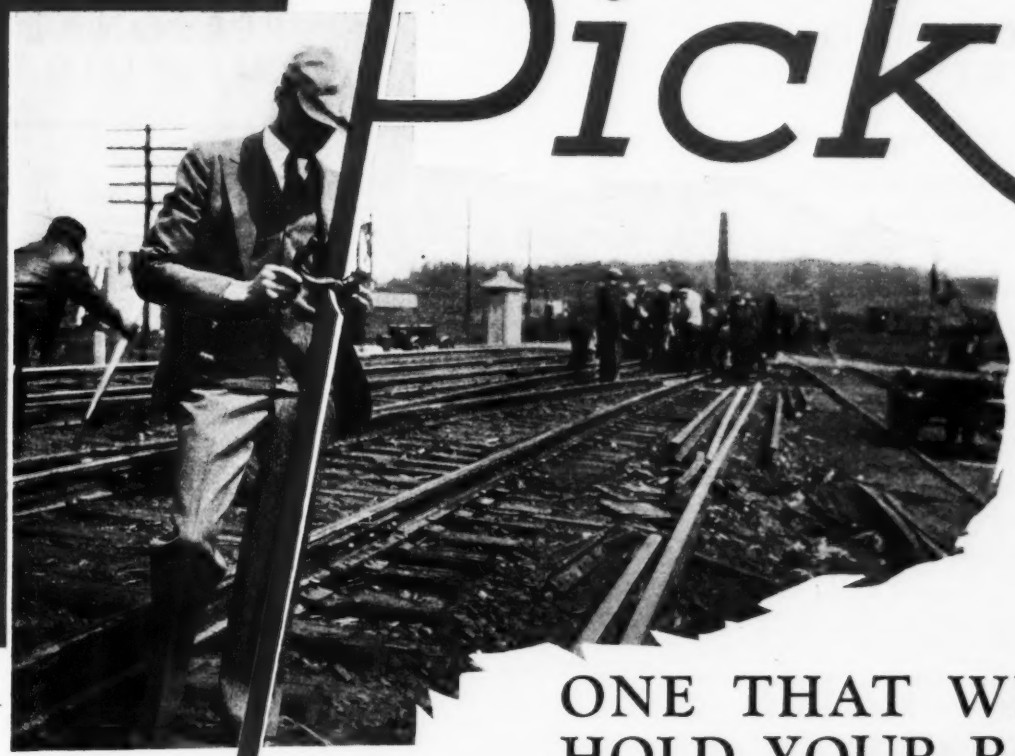
The 152-lb. section has been designed to meet the requirements of sustaining axle loads of 100,000 lb. at a speed of 100 miles per hour, as compared with the present requirements of axle loads of 80,000 lb. and speeds up to 80 miles per hour. The new section is 8 in. deep, or 1⅜ in. deeper than the present P. S. 130-lb. section, and will have a base width of about 6¾ in. The head will have side slopes of 1 in 40. The new rail will have approximately 75 per cent greater stiffness than the 130-lb. section now in use. The new 131-lb. section, which was designed along the same general lines as the new heavier section, possesses about 22 per cent greater stiffness and a marked increase in strength over the present 130-lb. section.

While 25,000 tons of the new 152-lb. rail is on order with the United States Steel Corporation and the Bethlehem Steel Company, none of this rail has been rolled as yet.

Correction

In connection with the article appearing on page 364 of the April issue, which described the track welding operations in the Proviso yard of the Chicago & North Western, it was stated in the tabulation on page 366 that 8,019 lb. of steel welding rods were used at the yard in 1930. This was a typographical error and should have read 2,019 lb.

Pick



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ASSOCIATION NEWS

American Railway Engineering Association

Committee work for the year is well organized and subcommittees are now making considerable progress on their assignments. Meetings held during April included those of the committee on Yards and Terminals at Ann Arbor, Mich., April 20; Water Service and Sanitation at Chicago, April 21; Maintenance of Way Work Equipment at Chicago, April 22; and Records and Accounts at Washington, D. C., April 23.

International Track Supervisors' Club

The International Track Supervisors' Club will hold its next meeting on May 21 at the Hotel Statler, Buffalo, N. Y. Luncheon will be served at 1 p. m. R. L. Morrison of the Morrison Railway Supply Company, Buffalo, N. Y., will present a paper on the subject of "Welding Crossings."

Maintenance of Way Club of Chicago

The last meeting of the club for the season, was held at the Auditorium Hotel on Wednesday evening, April 22, when John V. Neubert, chief engineer maintenance of way, New York Central, was the speaker of the evening. The meeting was preceded by a dinner attended by 109 members and guests. Mr. Neubert's subject was "Ballast, and Its Effect on Maintenance."

Metropolitan Track Supervisors' Club

The last meeting of the Metropolitan Track Supervisors' Club was held on April 23 at New York, and following dinner at 6:30 p. m., a paper was presented on "Six-Hole versus Four-Hole Joints" and "When and How Often Should Track Bolts Be Tightened," by a committee of which F. J. Meyer, assistant engineer maintenance of way, New York, Ontario & Western, was chairman.

Wood-Preservers' Association

The Executive committee has completed the selection of committees for the new year. For the committees whose work is of special interest to the railways, the following have been selected as chairmen: Preservatives, W. H. Fulweiler, chemical engineer, Philadelphia Gas Works Company, Philadelphia, Pa.; Treatment of Car Lumber, H. R. Duncan, superintendent timber preservation, C. B. & Q., Galesburg, Ill.; Treatment of Fir Lumber, R. H. Rawson, consulting engineer, Portland, Ore.; Pressure Treatment of Poles, R. H. Colley, Bell Telephone Laboratories, New York; Plant Operation, H. W. Foster, superintendent, Kettle River Treating Company, Madison, Ill.; Tie Service Records, W. R. Goodwin, engineer wood preservation, M. St. P. & S. S. M., Minneapolis, Minn.; Treatment of Bridge and Structural Timber, G. A. Haggander, bridge engineer, C. B. & Q., Chicago; Service Records, Poles, H. A. Haenseler, engineering department, Western Union Telegraph Company, New York; Service Records, Posts, F. McCrory, chief tie inspector, C. R. I. & P., Little Rock, Ark.; Treatment of Wood for Miscellaneous Purposes, E. P. Gowing, assistant to vice-president, American Creosoting Company, Louisville, Ky.

Tie Producers

The National Association of Railroad Tie Producers will hold its thirteenth annual convention at the West Baden Springs Hotel, West Baden, Ind., on May 5-7. The program for the convention is as follows:

Tuesday morning, May 5

Opening Business.

Address on the Shippers and Manufacturers' Transportation Association—What It is and What It is Doing, by E. E. Pershall, president, T. J. Moss Tie Company, St. Louis, Mo.

Address on Gum Ties on the Frisco, by Linn L. White, chief clerk, tie and timber department, St. L.-S. F., St. Louis, Mo.

Address on Tie Futures and Prosperity, by R. D. Garver, senior forester, Forest Products Laboratory, Madison, Wis.

Wednesday morning, May 6

Address on Identification of Fungi and Stains Permissible Under Standard Crosstie Specifications, by C. Audrey Richards, pathologist, Forest Products Laboratory, Madison, Wis.

Address on Relative Merits of Different Kinds of Woods Used for Crosstie Production, by W. R. Goodwin, engineer of wood preservation, M. St. P. & S. S. M., Minneapolis, Minn.

Address on Necessity for Greater Care in Handling Ties from Time of Cutting Until Delivered to Roads, by Horace Paul, chief tie inspector, Wabash, St. Louis, Mo.

Address on Does Tapping of Pine Trees Impair Resistance From Decay of Crossties Cut Therefrom? by C. S. Burt, superintendent ties and treatment, I. C., Grenada, Miss.

Address on Anti-Splitting Devices, by S. E. Shoup, assistant engineer, K. C. S., Kansas City, Mo.

Thursday morning, May 7

Address on Tie Practice on the Monon, by Anton Anderson, engineer maintenance of way, C. I. & L., Lafayette, Ind.

Reports of general conditions in tie industry by district directors.

Closing Business.

The annual dinner, which will be held on Wednesday evening, will be addressed by J. R. Koontz, vice-president in charge of traffic, St. Louis-San Francisco.

PERSONAL MENTION

General

J. S. Bassett, trainmaster on the Central division of the Missouri Pacific, with headquarters at Van Buren, Ark., and formerly division engineer on that road, has been appointed acting superintendent at McGehee, Ark.

H. C. Munson, division engineer of the Sioux City & Dakota division of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Sioux City, Iowa, has been promoted to trainmaster of the Kansas City division, with headquarters at Ottumwa, Iowa. Mr. Munson was born on June 25, 1901, at Oslo, Norway, and graduated from the University of Iowa with a degree in civil engineering

H. C. Munson

in 1923. In June of the same year he commenced railway service as a rodman on the Chicago, Milwaukee, St. Paul & Pacific, serving in this position and as instrumentman until 1928, when he was promoted to an assistant engineer on maintenance. In 1929, Mr. Munson was further promoted to division engineer of the Sioux City & Iowa division. His promotion to trainmaster became effective on April 1.

Engineering

R. H. Carpenter, assistant engineer on the Missouri Pacific, with headquarters at Poplar Bluff, Mo., has been transferred to McGehee, Ark., succeeding **W. A. Matson,** transferred. **A. F. Bradford,** assistant engineer at St. Louis, Mo., has been transferred to Wynne, Ark., succeeding **H. H. Heasley,** who has been transferred to Falls City, Neb.

Coincident with the extension of the Salt Lake division of the Los Angeles & Salt Lake to Daggett, Cal., to include part of the Los Angeles division, the position of **J. P. Mack,** division engineer of the latter division, with headquarters at Los Angeles, Cal., has been abolished,

and his duties consolidated with those of **R. L. Adamson,** chief engineer at Los Angeles. Mr. Mack has been assigned to other duties.

B. A. Ludgate, assistant engineer on the Pittsburgh & Lake Erie, with headquarters at Pittsburgh, Pa., has retired from active service.

O. V. Derr, general office engineer of the Erie, has been promoted to valuation engineer, with headquarters as before at New York, succeeding **C. H. Moore. H. J. Stroebel,** assistant engineer in charge of order No. 3 section, has been appointed assistant valuation engineer, with headquarters also at New York.

Heron Cabrera, formerly engineer of right of way on the National Railways of Mexico, with headquarters at Tampico. Tam., has been appointed chief engineer, with headquarters at Mexico, D. F., succeeding **Aurelio Chavez,** whose death is noted elsewhere in these columns.

Following the absorption of the Indiana division of the Illinois Central by the Illinois and Springfield divisions, **F. W. Armistead,** division engineer of the former division, with headquarters at Mattoon, Ill., has been transferred to the Springfield division, with headquarters at Clinton, Ill., succeeding **H. C. Hayes,** who has been appointed assistant engineer at Champaign, Ill., where he succeeds **J. H. Davis,** who has been assigned to other duties. **W. D. Shenefield,** assistant engineer at Mattoon, has been assigned to other duties.

Owing to a rearrangement of the operating divisions of the Pere Marquette, **R. A. Morrison,** division engineer of the Port Huron-Grand Rapids division, with headquarters at Saginaw, Mich., has had his headquarters transferred to Detroit, Mich., with jurisdiction over the Detroit-Grand Rapids division. **A. R. Dewees,** division engineer of the former Detroit-Canadian division, now has jurisdiction over the Canadian division and the Detroit terminals, with headquarters as before at Detroit.

B. O. Johnson, resident engineer on the Chicago, Milwaukee, St. Paul & Pacific on the construction of the joint line of this road and the Chicago, Rock Island & Pacific between Polo,. Mo., and Birmingham, has been promoted to division engineer of the Sioux City & Dakota division, with headquarters at Sioux City, Iowa, succeeding **H. C. Munson,** whose promotion to trainmaster is noted elsewhere in these columns. The position of resident engineer formerly held by Mr. Johnson has been discontinued as the work on the new line is nearing completion. Mr. Johnson was born on October 7, 1899, at Ottumwa, Iowa, and after completing a public school education, entered the service of the Chicago, Milwaukee, St. Paul & Pacific on May 4, 1918, as a rodman on construction. On March 1, 1919, he was transferred to maintenance work, being promoted to instrumentman on May 1, 1921, which position he held until July 1, 1929, when he was further advanced to assistant engineer on line revision work at Sioux City. On April 1, 1930, Mr. Johnson was promoted to resident engineer on the Polo-Birmingham line. His promotion to division engineer became effective on April 1.

G. R. Smiley, chief engineer of construction of the Louisville & Nashville, has been appointed assistant chief engineer, with headquarters as before at Louisville, Ky. Mr. Smiley has served in various capacities in the construction and engineering departments of a number of railroads for nearly 29 years. He was born on February 6, 1881, at Moffatts Creek, Va., and graduated from Washington and Lee University in 1902. He entered railway service on September 8 of the same year as a rodman on the New York Central & Hudson River (now the New York Central), being advanced successively through the positions of instrumentman, assistant supervisor of track and assistant engineer in the bridge department. In October, 1905, he went with the Florida East Coast as resident engineer and assistant superintendent of construction in charge of dredging operations. He was appointed division engineer in September, 1908, and served in this position and as superintendent of construction in charge of bridge and track work until November, 1911. In May, 1912, Mr. Smiley became connected with the Louisville & Nashville as a resident engineer, which position he retained until July 15, 1915, when he went with the Nashville, Chattanooga & St. Louis as assistant engineer on construction. On January 15, 1917, he was appointed special engineer on the Louisville & Nashville, being in September of the same year appointed assistant engineer in the office of the chief engineer of construction. Mr. Smiley was promoted to chief engineer of construction on October 1, 1920.

Track

M. L. Stage, roadmaster on the Missouri Pacific, with headquarters at Helena, Ark., has retired from active service.

G. Wilmoth, roadmaster on the Chicago, Rock Island & Pacific, with headquarters at Enid, Okla., has retired from active service.

O. Anderson, roadmaster on the Los Angeles & Salt Lake, with headquarters at Los Angeles, Cal., has been transferred to Kelso, Cal., succeeding **A. L. Hilburn,** who has been assigned to other duties. The position of roadmaster at Los Angeles has been abolished and the duties consolidated with those of **P. A. Pheney,** general roadmaster at Los Angeles.

J. T. Amos, track supervisor on the Louisville & Nashville, with headquarters at Evergreen, Ala., retired from active service on March 1, after more than 56 years of service with that road. Mr. Amos had been a supervisor for 40 years.

J. H. McInnes, section foreman on the Sprague subdivision of the Canadian National with headquarters at Giroux, Manitoba, has been appointed acting roadmaster on the Allanwater subdivision, with headquarters at Sioux Lookout, Ontario, succeeding **A. E. Lyons,** who has been transferred to the Quibell subdivision, with the same headquarters, succeeding **S. H. Miller,** transferred.

C. I. Van Arsdalen, division engineer of the St. Louis division of the Illinois Central, with headquarters at East St. Louis, Ill., has been appointed supervisor of track, with the same headquarters, following the discontinuance of the position of division engineer at this point. **M. Sheahan,** supervisor of track at Rantoul, Ill., has retired and his position has been abolished, the territory being divided among a number of supervisors. **C. M. Goddard** and **P. Moyers,** supervisors at Harriston, Miss., and Vicksburg, respectively, have been assigned to other duties, and their territories allotted to other supervisors. **T. B. Greer,** supervisor with headquarters at La Salle, Ill., has moved his headquarters to Bloomington, Ill.

Bridge and Building

H. H. Best, assistant master of bridges and buildings of the Toledo, Peoria & Western has been promoted to master of bridges and buildings, with headquarters as before at Peoria, Ill., succeeding **J. H. Markley,** whose death is noted elsewhere in these columns.

W. R. Langston, acting bridge and building supervisor on the Louisiana & Arkansas, with headquarters at Minden, La., has been promoted to bridge and building supervisor, with the same headquarters, to replace **N. D. Zenor,** whose death is noted elsewhere in these columns.

C. L. Marks, assistant supervisor of bridges and buildings on the Richmond division of the Chesapeake & Ohio, has been promoted to supervisor of bridges and buildings with headquarters as before at Richmond, Va. Mr. Marks succeeds **Isaac Garrison,** whose death was noted in the February issue.

Owing to a rearrangement of the operating divisions of the Pere Marquette, **J. P. Woods,** supervisor of bridges and buildings on the Port Huron-Grand Rapids division, with headquarters at Saginaw, Mich, has been transferred to the Detroit-Grand Rapids, division, with headquarters at Grand Ledge, Mich. **C. F. Weir,** supervisor of bridges and buildings on the Detroit-Canadian division, with headquarters at Detroit, Mich., has had his headquarters moved to St. Thomas, Ont., where he has jurisdiction over the Canadian division and the Detroit terminals.

J. D. Searles, bridge and building supervisor with the Oregon-Washington Railroad & Navigation Co., with headquarters at Walla Walla, Wash., has been transferred to the Third division with headquarters at Spokane, Wash., where he succeeds **W. S. Miller,** transferred. **E. Larkin,** bridge and building

supervisor with headquarters at La Grande, Ore., has had his territory extended to include portions of the Third division.

W. G. McDonald, supervisor of buildings on the Chicago, Burlington & Quincy, Lines West, with headquarters at Lincoln, Neb., has been appointed supervisor of bridges and buildings, Lines West, with the same headquarters, a newly created position. **W. F. Bucknell,** supervisor of bridges, Lines West, at Lincoln, has been appointed master carpenter, with headquarters at Hannibal, Mo. The positions of supervisor of buildings and of supervisor of bridges, Lines West, have been discontinued.

Following the absorption of the Indiana division of the Illinois Central by the Illinois and Springfield divisions, **P. H. Carlson,** bridge and building supervisor of the Indiana division, with headquarters at Mattoon, Ill., has been transferred to the St. Louis division, with headquarters at Carbondale, Ill., where he succeeds **J. W. McKinney,** who has retired.

F. M. Bigelow, supervisor of bridges and buildings of the Los Angeles division of the Los Angeles & Salt Lake, with headquarters at Los Angeles, Cal., has been granted an extended leave of absence and his position abolished. Bridge and building matters of the Los Angeles division have been placed under the jurisdiction of **R. L. Adamson,** chief engineer at Los Angeles.

Obituary

George Cottingham, Jr., division engineer on the Chicago Great Western, with headquarters at Oelwein, Iowa, died at that place on April 19.

J. L. Jensen, roadmaster on the Chicago, Rock Island & Pacific, with headquarters at Rock Island, Ill., died on April 14.

A. Yappen, assistant engineer of bridge maintenance on the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Chicago, died on April 4, at Rochester, Minn.

A. H. Stone, who was assistant engineer on the construction of the Kansas City (Mo.) Terminal from 1912 to 1915, died at Sanford, Fla., on April 2, where he had been located during the past few years.

Aurelio Chavez, chief engineer of the National Railways of Mexico, with headquarters at Mexico, D. F., died in that city on April 20 as the result of injuries received when his inspection motor car was derailed on the Cuernavaca branch on April 18.

Charles P. Yardley, former maintenance engineer on the New York division of the New York, New Haven & Hartford, died at his home in Larchmont, N. Y., on March 9. Mr. Yardley, who was born on July 15, 1881, entered railway service in 1903 with the New Haven. After 14 years of continuous service in the maintenance of way department, he was appointed maintenance engineer of the New York division on May 20, 1917, which position he held until June, 1930, when he was given an indefinite leave of absence because of illness.

W. T. Patterson, who retired on February 1 as a track supervisor on the Louisville & Nashville, with headquarters at Shepherdsville, Ky., died at Louisville, Ky., on March 5, at the age of 61 years. Mr. Patterson had been in the service of the L. & N. for more than 44 years.

Leverett S. Miller, whose railway career comprised broad experience in the engineering and maintenance of way fields and who retired as president of the New York, Westchester & Boston, on July 1, 1930, died on March 21 at the age of 65 years. A photograph and biographical sketch of Mr. Miller appeared in the August, 1930, issue of *Railway Engineering and Maintenance.*

N. D. Zenor, supervisor of bridges and buildings of the Louisiana & Arkansas, with headquarters at Minden, La., died on March 2, at Winnfield, La. Mr. Zenor was born on May 10, 1867, at Ames, Iowa, and in 1896 he became a bridge and building foreman on the St. Louis-San Francisco. In 1903, he left this road to accept a similar position with the St. Louis Southwestern, where he served until August 10, 1909, when he went with the Louisiana & Arkansas. Ten years later he was promoted to supervisor of bridges and buildings, which position he held until his death.

John H. Markley, master of bridges and buildings of the Toledo, Peoria & Western, with headquarters at Peoria, Ill., died at his home in that city on March 28 from blood poisoning. Mr. Markley has been in the service of the T. P. & W. for nearly 46 years. He was born on November 8, 1856, at North Wales, Pa., and entered the service of the T. P. & W. in 1885, as a bridge and building foreman. After serving for a time in this capacity he was promoted to master of bridges and buildings, holding this position until his death. Mr. Markley was a past president of the American Railway Bridge & Building Association, having held that position in 1906-07.

Francis H. McGuigan, formerly general roadmaster on the Wabash and at one time vice-president of the Grand Trunk, whose death was announced in the April issue was born in 1850 at Cleveland, Ohio, and entered railway service in 1863 as a water boy on the Erie & Pittsburgh division of the Pennsylvania. During the next 11 years he held minor positions with this company and in 1874 was promoted to roadmaster. From July 1, 1880 to January 1, 1885, he was division roadmaster on the Wabash. Later he was general roadmaster until 1888 when he was made superintendent. On February 15, 1896, he was made general superintendent of the Grand Trunk. On March 1, 1902, was promoted to manager, and on January 1, 1905, to vice-president.

SUPPLY TRADE NEWS

General

The Harnischfeger Sales Corporation, Milwaukee, Wis., has moved its New York office to the Empire State Building.

The Pittsburgh-Des Moines Steel Company, Pittsburgh, Pa., has moved its New York office from 50 Church street to 270 Broadway.

Premax Products, Inc., Niagara Falls, N. Y., which has been in receivership since last October, has been reorganized and is now known as **Premax Products Corporation.**

The American Steel & Wire Company has purchased the business and smelting plant of the **Edgar Zinc Company,** St. Louis, Mo. The smelter is located at Cherryvale, Kan.

The Bucyrus-Erie Company, South Milwaukee, Wis., has taken over the manufacture and sale of the Loadmaster, a revolving boom crane formerly marketed by **Frederic H. Poor,** Inc., New York.

The Ingot Iron Railway Products Company, which handles the sales of corrugated metal culverts, spiral welded pipe and metal cribbing to the railroads for the **American Rolling Mill Company,** Middletown, Ohio, has opened a district sales office at 1120 Midland Bank building, Cleveland, Ohio. **J. M. Harrod** is the district sales manager.

The United States Steel Corporation has arranged a long term lease for office space for several of its subsidiary companies in the Empire State building, Thirty-fourth street and Fifth avenue, New York City, as follows: **American Steel & Wire Company, Lorain Steel Company, Oil Well Supply Company** and **Wilson-Snyder Manufacturing Company.**

The Shepard Niles Electric Crane & Hoist Corporation, Montour Falls, N. Y., recently changed its sales office in Pittsburgh, Pa., to the Grant building. **Roy M. Hurst,** until recently located in this company's New York office, will be in charge as district manager and will be associated with **Frank J. Kinney.** This corporation has also changed its sales office at Cleveland, Ohio, to 1433 East Twelfth street with **Harry A. Baugh** in charge as district manager.

At the annual meeting of the stockholders of the **Monighan Manufacturing Corporation,** which was recently acquired by the **Bucyrus-Erie Company,** South Milwaukee, Wis., the stockholders voted to change the name of the company to the **Bucyrus-Monighan Company.** This action has also been approved by the board of directors of the Bucyrus-Erie Company. The Bucyrus-Monighan Com-

pany will operate as a separate organization, except that sales will be handled by the Bucyrus-Erie sales organization. Officers of the Monighan Company were re-elected as officers of the Bucyrus-Monighan Company, while **W. W. Coleman,** president, and **G. A. Morison,** vice-president and treasurer of the Bucyrus-Erie Company, were elected chairman and vice-chairman of the Bucyrus-Monighan Company respectively.

Personal

W. S. Boyce, assistant to the president of the **Railroad Supply Company,** Chicago, has resigned.

O. T. Leavenworth of the railways bureau of the **Portland Cement Association,** with headquarters at Chicago, has resigned to become a partner in the **National Concrete Machinery Company,** Madison, Wis.

H. H. Perry, vice-president and a director of the **Industrial Brownhoist Corporation,** Cleveland, Ohio, has resigned to become vice-president and general manager of the **Whitcomb Locomotive Company,** a subsidiary of the **Baldwin Locomotive Works.**

William L. Brown has been appointed special representative of the **Argyle Railway Supply Company,** Chicago, with headquarters at 1600 Arch street, Philadelphia, Pa., and will handle the sale of stoves and driers in that territory.

Edwin T. Hall, representative of the **Sullivan Machinery Company,** with headquarters at Boston, Mass., has been promoted to manager of that office to succeed **George H. Richey,** who died on April 1.

J. B. Bartholomew, formerly western manager of sales engineers in the Chicago office of the **Bethlehem Steel Company,** has been appointed contract manager for the **McClintic-Marshall Corporation,** with headquarters at Chicago.

William S. Miller has resigned as manager of railroad sales of the **Northwest Engineering Company,** with headquarters at Chicago, to take charge of railroad sales for the **Bucyrus-Erie Company,** with headquarters at South Milwaukee, Wis., effective May 1.

George L. Niederst, for the past 20 years chief engineer of the **Orton Crane & Shovel Company,** Chicago, has left that company to become engineering sales representative of **Thomas D. Crowley & Company,** railroad representatives for the Orton Crane & Shovel Company.

C. F. Wiley, assistant manager of the electric wire and rope department of the **American Steel & Wire Company,** with headquarters at Chicago, has been promoted to manager of this department to succeed **C. S. Knight,** deceased. **John May,** assistant manager of sales of electric wire and rope, has been promoted to assistant general manager of sales in charge of electric wire, rope and specialties, and has been succeeded by **A. H. Mowry,** assistant manager of sales of electric wire and rope. **H. D. Sharp,** manager of sales of electric wire and rope at Boston, Mass., has been transferred to Worcester.

William G. Clyde, who resigned in September, 1930, as president of the Carnegie Steel Company, on account of ill health, died at his home in Pittsburgh, Pa., on March 23 at the age of 62 years. A photograph and sketch of Mr. Clyde's career appeared in the October, 1930, issue of *Railway Engineering and Maintenance.*

Glenn W. Christopher, manager of the bar and wire sales of the **Youngstown Sheet & Tube Company,** Youngstown, Ohio, has been promoted to assistant manager of pipe and sales, and has been succeeded by **William W. Brown,** district manager of sales at Pittsburgh, Pa., who, in turn, has been succeeded by **Guy B. Strausner,** district manager at Buffalo, N. Y. Mr. Strausner has been succeeded by **Clyde F. Andler,** district manager at Youngstown, and the latter has been replaced by **Earl H. Braunbern,** assistant district sales manager at Youngstown. **Robert D. MacKenzie,** acting district sales manager at Cleveland, Ohio, has been appointed district

Trade Publications

Locomotive Coaler—The Roberts and Schaefer Company, Chicago, has recently issued a 12-page bulletin describing and illustrating its new N. & W. type electric engine coaler for delivering coal from the car to the locomotive tender.

Pillar and Mast Jib Cranes—The Industrial Brownhoist Corporation, Cleveland, Ohio, has recently issued Booklet 316 which describes this company's complete line of pillar and mast jib cranes. The booklet contains 12 pages and is attractively illustrated.

Highway-Rail Crossing.—The A. O. Smith Corporation, Milwaukee, Wis., has issued a six-page illustrated folder containing a description of its Smithsteel Highway-Rail crossing, and also instructions for its installation.

Vibro-Cast Concrete Placement.—The vibro-cast method of placing concrete by attaching a vibrating motor to the forms is treated comprehensively in a 16-page booklet recently issued by the Electric Tamper & Equipment Company, Chicago.

Diamond Vulcanized Fibre—The Continental-Diamond Fibre Company, Newark, Del., has recently issued a 40-page illustrated booklet bearing this title, containing a complete account of the manufacture and use of Diamond Vulcanized Fibre.

Electric Arc Welding—This is the name of a handbook of 80 pages published by Hobart Brothers Company, Troy, Ohio, which presents many facts on the application and technic of electric welding. It also contains descriptions of electric welding materials and appliances manufactured by the Hobart Company.

Hydraulic Dirtmovers—A 12-page illustrated booklet which has recently been issued by the American Tractor Equipment Company, Oakland, Cal., describes and illustrates this company's Ateco Hydraulic Dirtmover for use with Caterpillar tractors.

Medusa Portland Cement Paint.—The Medusa Portland Cement Company, Cleveland, Ohio, is distributing a 16-page booklet, entitled "How to Paint Concrete Surfaces," which contains a discussion of the various applications of Medusa portland cement paint.

Electric Shovel and Dragline—A complete description of the new 75-B 2½-cu. yd., electric shovel and dragline of the Bucyrus-Erie Company, South Milwaukee, Wis., is contained in a new bulletin which has been published by the company.

Railroad Calcyanide—The Calcyanide Company, New York, has issued a folder, Form A, concerning its product, railroad calcyanide, a powder which gives off a gas capable of killing all forms of vermin. The folder includes a description of the product and its merits, the method of its application and statements from roads which have used the product.

Scraper Mucking—A handbook bearing this title and containing a thorough and comprehensive treatment of the subject has recently been issued by the Sullivan Machinery Company, Chicago. The book contains 118 pages and discusses elementary set-ups, scraper design, equipment and accessories, hoists, and scraper mucking.

Cranes and Excavating Equipment.—The American Hoist & Derrick Co., St. Paul, Minn., has recently issued two illustrated bulletins, each of which is devoted to a unit of this company's products. One bulletin has four pages and contains a list of some of the users of the American Gopher, while the other comprises 12 pages and describes the American Eagle crane.

Gas Plus Air.—A bulletin containing a complete description of the new GA-3 machine, convertible to shovel, dragline, clamshell, or lifting crane, has recently been issued by the Bucyrus-Erie Company, South Milwaukee, Wis. The 20-page bulletin is attractively illustrated, and gives considerable space to a discussion of the application of the gas-plus-air principle.

Handbook of Concrete Construction.—The Universal Atlas Cement Company, Chicago, has issued a handbook of 208 pages intended primarily for the builder of concrete and reinforced concrete although it contains information on estimating that will prove of value to others. It presents in concise form practical instruction on the making of good concrete, details of form construction and suggestions on the use of concrete.

STATEMENT of the ownership, management, circulation, etc., required by the Act of Congress of August 24, 1912, of *Railway Engineering and Maintenance*, published monthly at Milwaukee, Wis., for April, 1931.

State of Illinois } ss.
County of Cook }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Elmer T. Howson, who, having been duly sworn according to law, deposes and says that he is the editor of the *Railway Engineering and Maintenance*, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Simmons-Boardman Publishing Company, 30 Church St., New York, N. Y.

Editor, Elmer T. Howson, 105 West Adams St., Chicago, Ill.

Managing Editor, Walter S. Lacher, 105 West Adams St., Chicago, Ill.

Business Manager, F. C. Koch, 30 Church St., New York, N. Y.

2. That the owners are:

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3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

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ELMER T. HOWSON.

Sworn to and subscribed before me this 25th day of March, 1931. HELEN E. PITMAN.

[Seal] (My commission expires Feb. 3, 1932.)

ADVANCE NOTICE . . . .

Owing to the many requests for reprints within one cover of the series of articles on "The Operation and Maintenance of Track Motor Cars," by C. R. Knowles which have been appearing serially in Railway Engineering and Maintenance since January, 1930 and conclude in this issue, we are contemplating the reprinting of these articles in a booklet of some 66 pages, bound in an attractive cover.

This series of articles, 15 in number, contains a vast fund of practical information on the design, use and care of motor cars that has long been sought by maintenance men.

The subjects covered in detail in this series are as follows:

1—The Place of the Track Motor Car in Maintenance Work.
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7—The Care of a Motor Car.
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These booklets will be available at 50 cents per copy. To roads or companies desiring 100 copies or more, special prices will be quoted on request, if ordered before May 15.

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Louisville Frog, Switch & Signal Co.
National Lock Washer Co.
Reliance Manufacturing Co.
Verona Tool Works.
Woodings Forge & Tool Co.

Nuts
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Illinois Steel Co.
Louisville Frog, Switch & Signal Co.

Out Houses
Massey Concrete Products Corp.

Oxy - Acetylene Welding Equipment
Oxweld Railroad Service Co.

Oxygen
Oxweld Railroad Service Co.

Paint
E. I. Dupont de Nemours & Co., Inc.
National Lead Co.
U. S. Graphite Co.

Paint, Graphite
U. S. Graphite Co.

Paint, Metal Protecting
E. I. Dupont de Nemours & Co., Inc.
National Lead Co.
U. S. Graphite Co.

Pavement Breakers
Ingersoll-Rand Co.
Sullivan Machinery Co.

Penstocks
Fairbanks, Morse & Co.

Pile Drivers
Bucyrus-Erie Co.
Industrial Brownhoist Corp.
Ingersoll-Rand Co.

Piling
Bethlehem Steel Co.
Carnegie Steel Co.
Massey Concrete Products Corp.
Southern Wood Preserving Co.

Pipe Carriers
Massey Concrete Products Corp.

Pipe, Cast Iron
Central Foundry Co.
Massey Concrete Products Co.

Pipe, Corrugated
Armco Culvert Mfrs. Assn.
Gohi Culvert Mfrs., Inc.

Pipe, Sewer
Armco Culvert Mfrs. Assn.
Central Foundry Co.
Massey Concrete Products Corp.

Plates, Miscellaneous
Louisville Frog, Switch & Signal Co.
Ramapo Ajax Corp.

Plows
Western Wheeled Scraper Co.

Poles
Jackson Lumber Co.
Massey Concrete Products Corp.
Southern Wood Preserving Co.

Power Jack
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Southwark Foundry & Machine Co., Div.
Nordberg Mfg. Co.

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Syntron Co.

Preservation, Timber
Curtin-Howe Corp.
Southern Wood Preserving Co.

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Ingersoll-Rand Co.
Layne & Bowler, Inc.
Sullivan Machinery Co.

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Fairmont Railway Motors, Inc.

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Timken Roller Bearing Co.

Rail Anchors
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Bethlehem Steel Co.
Louisville Frog, Switch & Signal Co.
Lundie Engineering Corp.
P. & M. Co.
Verona Tool Works
Woodings Forge & Tool Co.

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O. & C. Co.
Verona Tool Works.

Rail Bonds
American Steel & Wire Co.
Verona Tool Works.

Rail Braces
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Louisville Frog, Switch & Signal Co.
O. & C. Co.
Ramapo Ajax Co.
Wharton, Jr. & Co., Wm.

Rail Expanders
Ramapo Ajax Corp.

Rail Layers
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Cullen-Friestedt Co.
Maintenance Equipment Co.
Nordberg Mfg. Co.

Rail Saws, Portable
Industrial Brownhoist Corp.
Syntron Co.

Rail Shims
American Fork & Hoe Co.

Rail Springs
Verona Tool Works.

Rail Tester
Sperry Products, Inc.

Rails, Girder
Bethlehem Steel Co.

Rails, Tee
Bethlehem Steel Co.
Carnegie Steel Co.
Louisville Frog, Switch & Signal Co.

Reconditioning, Rail Crossing & Frogs
Morrison Railway Supply Corp.
Syntron Co.

Retaining Walls, Precast
Federal-American Cement Tile Co.
Massey Concrete Products Corp.

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Bethlehem Steel Co.
Louisville Frog, Switch & Signal Co.

Rock Hammers
Ingersoll-Rand Company

Rods, Welding
Oxweld Railroad Service Co.
Syntron Co.

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Federal-American Cement Tile Co.
Massey Concrete Products Corp.

Roofing, Cement & Concrete Tile
Federal-American Cement Tile Co.

Rules
Lufkin Rule Co.

Rust Preventive
Dearborn Chemical Co.

Safety Flags
Louisville Frog, Switch & Signal Co.

Saw Rigs
American Saw Mill Machinery Co.
Fairbanks, Morse & Co.

Saws, Electric
Reed-Prentice Corp.
Syntron Co.

Saws, High Speed Friction
American Saw Mill Machinery Co.

Saw Mills
American Saw Mill Machinery Co.

Saws, Portable, Rail
O. & C. Co.
Syntron Co.

Saws, Timber
Reed-Prentice Corp.
Syntron Co.

Scales, Tape
Lufkin Rule Co.

Scales, Track
Fairbanks, Morse & Co.

Screw Spikes
Bethlehem Steel Co.
Illinois Steel Company.

Screw Spike Drivers
Ingersoll-Rand Co.
Nordberg Mfg. Co.
Syntron Co.

Sharpeners, Rock Drill Steel
Ingersoll-Rand Co.

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Armco Culvert Mfrs. Assn.

Shovels
Verona Tool Works.
Woodings Forge & Tool Co.

Shovels, Gasoline Revolving
Buckeye Traction Ditcher Co.

Signals, Bridge & Warning
Hastings Signal & Equipment Co.

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Armco Culvert Mfrs. Assn.

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Northwest Engineering Co.

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O. & C. Co.

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Illinois Steel Co.

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O. & C. Co.

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Illinois Steel Company.

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Steel, Open Hearth
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Timken Roller Bearing Co.

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Illinois Steel Company.

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Timken Roller Bearing Co.

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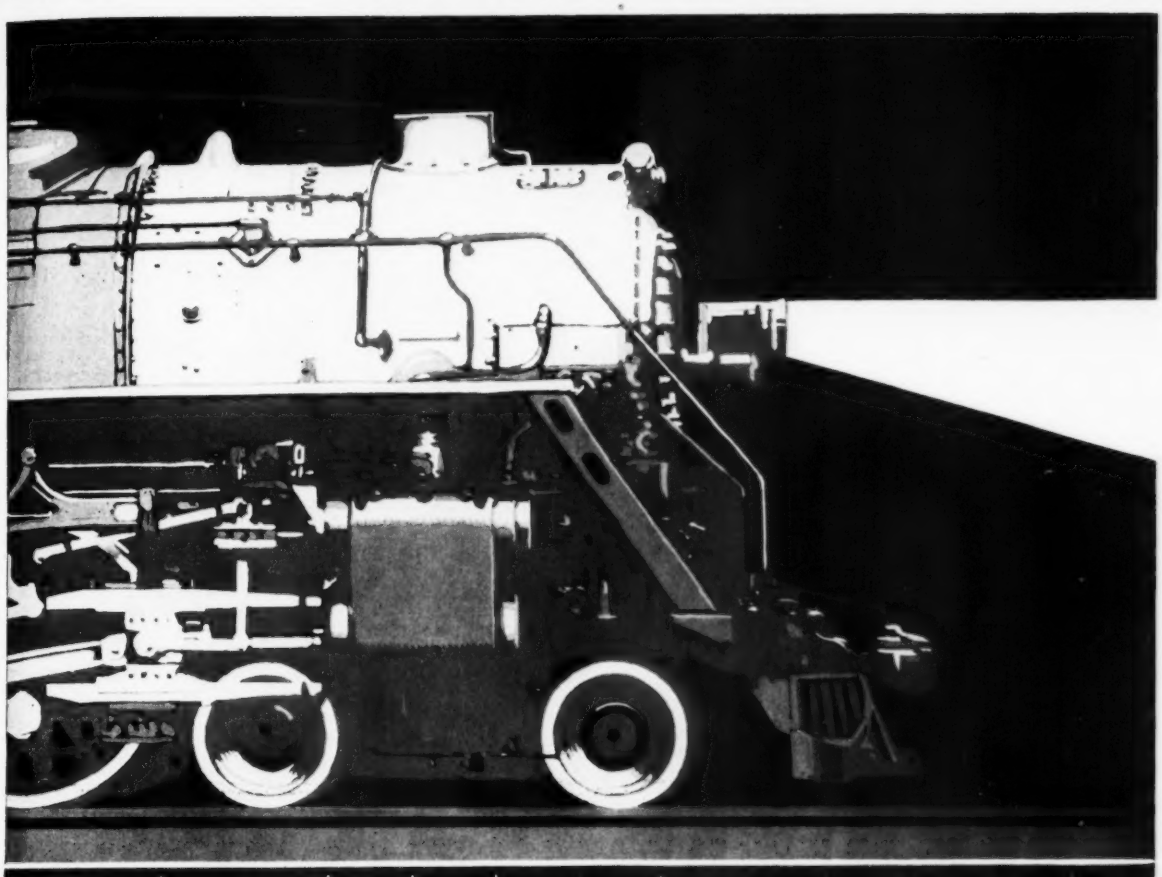

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